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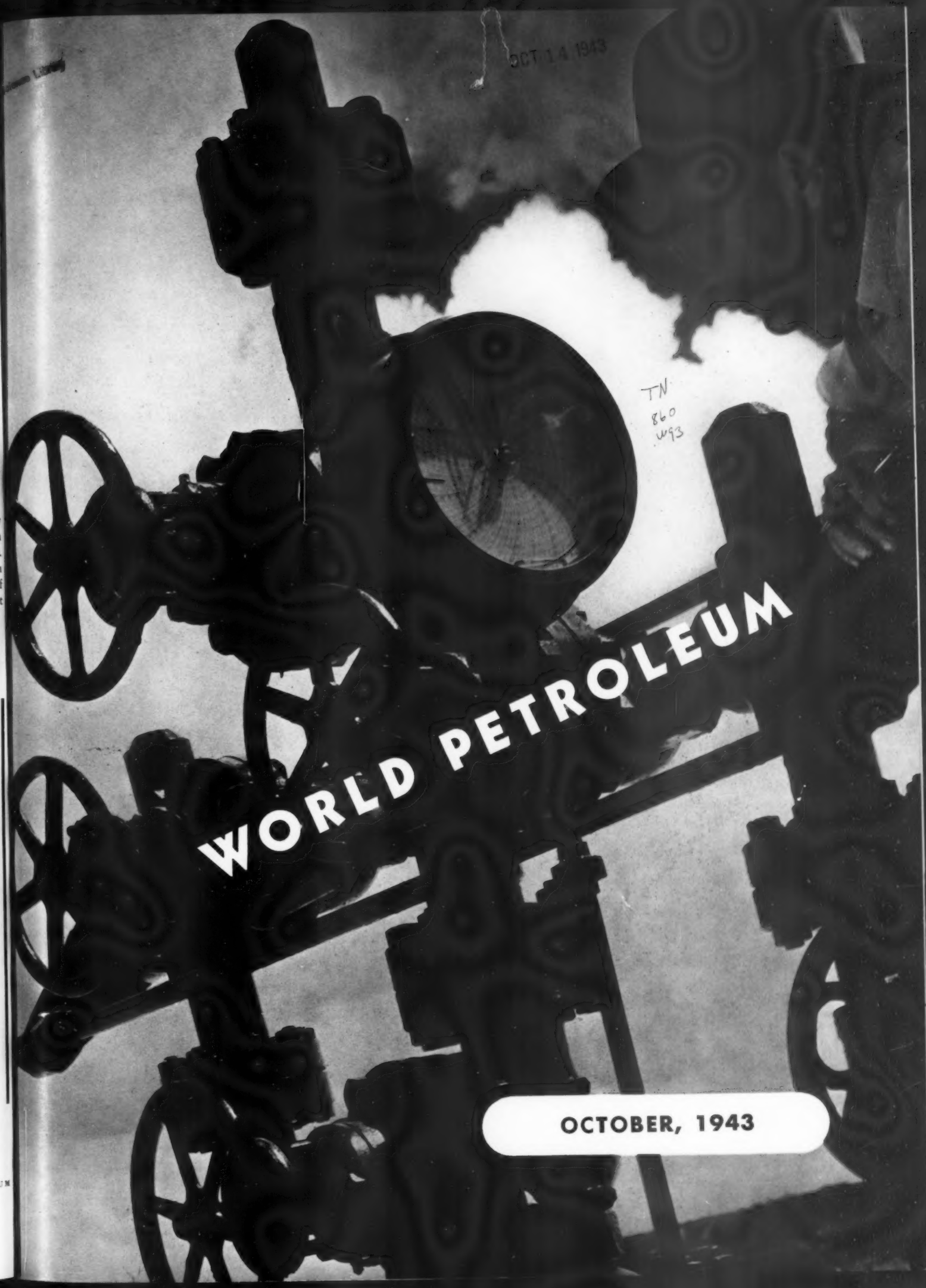

WORLD PETROLEUM

OCTOBER, 1943

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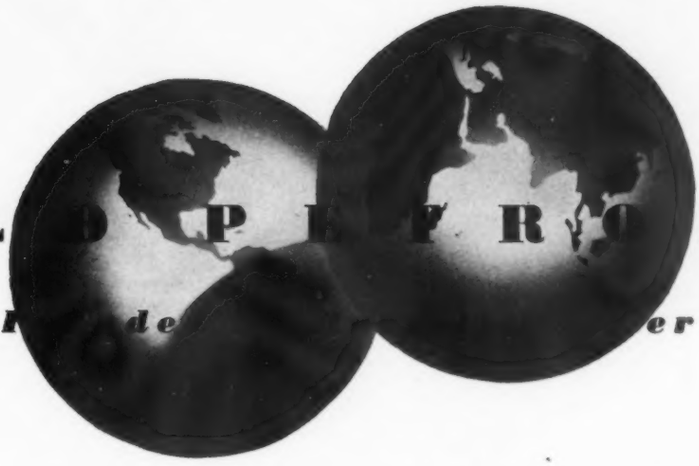

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THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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EDITORIAL

U. S. NEEDS A FOREIGN OIL POLICY

JUST as petroleum is playing a vital part in the conduct of the war, so it is inevitable that many important problems, domestic and international, will center about this same commodity in the post-war period. There are several reasons why this is certain to be the case.

Because of the war the oil industry has departed widely from the settled course which it followed before the commencement of the conflict. In the United States the industry's activities have been concentrated on provision of the products especially needed for military use. After the war the demand for some of these specialized products will disappear, while in the case of others it will shrink to much smaller proportions. Excess capacity for high octane gasoline, toluene and some other products will be in existence; transportation facilities will be much above peacetime requirements and the reestablishment of marketing outlets that have fallen into disuse will involve many difficulties and possibly may entail heavy losses. By and large, however, the adjustment to new conditions probably can be made more readily in the case of oil than that in some other industries because there is unlikely to be a decrease in demand but rather a shift between products.

More serious will be the problems faced in the international operations of the industry. Because of oil's importance in the war, petroleum installations have been special objects of attack and have suffered more than almost any other form of property. The destruction still continues and before the fighting ends will have laid waste the fields and refineries, the storage and transportation equipment, of a large part of the world.

Because of the war, trade routes and services have been disrupted. The lines of traffic and the mechanism of distribution over great areas have ceased to operate. Whole countries will have been forced to do without petroleum products so far as the majority of their citizens are concerned for a number of years. They will need oil and the machines that move by oil to restore their disordered industries and to resume their accustomed ways of life. Until the damage that has been wrought can be repaired, the demand upon those countries whose petroleum resources have not been impaired will be extremely heavy, heavier perhaps than during the war itself in the case of certain products. The clamor of the petroleum have-nots for a share in the output of the haves will be loud and insistent. Unless it is heeded, economic strangulation will be their fate and they will prove a drag upon world recovery.

War has made the people of every part of the world oil conscious as they never were before. They will demand improved transportation and motorized machinery to replace lost manpower in their agriculture and industry. Every nation now realizes the economic and strategic value of oil, recognizes that those who control petroleum resources will command the future. Each one will want to be assured of possession of, or access to, petroleum supplies. Questions concerning oil will assume urgent importance in the making of the peace and in its future preservation.

As the United States is still the greatest producer and consumer of petroleum and as its citizens have led the way in the discovery and development of oil, this country has the opportunity to exercise a far-reaching influence upon the solution of these problems. In order to do so, it is obvious that the government should have a sound and definite foreign oil policy, not merely for selfish reasons but in the interests of economic peace and progress for other nations as well.

The war itself has led to the taking of certain steps towards the development of such a policy. The measures adopted to assure an equitable distribution of petroleum products to other American countries faced with a shortage, in which the State Department has taken an active interest, is a move in this direction. The allocation of drilling, pipe line, and refinery equipment to places where they will be most useful in expanding war supplies is another. The establishment of the government owned Petroleum Reserves Corporation, with broad powers to engage in the oil business in any part of the world, is generally looked upon as intended to provide a vehicle for the exercise of a very direct and definite influence on the international petroleum situation now and in the post-war period.

Thus far, the operations and the plans of this corporation, if such plans actually have been formulated, are cloaked with the veil of military secrecy so that little can be said of their scope or purpose. So far as they are concerned with purely military measures, no fault can be found with this secretiveness, but it is in order to point out that as the policy takes form and substance, it must be brought into the open and submitted to the test of public opinion. That such opinion will support a liberal use of the resources and abilities of the nation is beyond doubt but it also will demand the safeguarding of American rights and the protection of American property and citizens. Any scheme of cooperation in the development of the oil resources or the provision of oil supplies for other nations that does not provide such safeguards will be foredoomed to rejection.

of Bayway Cat Cracking
f Standard Oil Co. (N.J.)

This Standard refinery produces gasoline but hundreds of its workmen ride bicycles.

DEMANDS GROW FOR OIL INVESTIGATION

Conflicting Claims and Clashing Authority Point Need of an Inquiry That Will End Confusion and Provide Public with a Clear Understanding of the Situation.

IT IS NOT surprising that demands are arising for an investigation of the oil situation in the United States. That is the American way, and particularly the Congressional way, of dealing with conditions that are the subject of conflicting claims, that result in controversies between government agencies or that bear an odor of possible maladministration. In the case of petroleum requests for official inquiries have been voiced repeatedly in and out of Congress during the past two years. They are now being heard in rising volume with demands for a probe into production, transportation, and distribution.

Such an investigation by an independent and unbiased body appears now to be desirable—perhaps it may be better defined as necessary—for several reasons. The facts are well known and generally agreed upon within the oil industry, but they are not well understood by the consumer public, which has been confused by contradictory explanations offered it from Washington. The Office of Price Administration, which exercises decisive control over oil through its authority to regulate prices and distribution, has developed a degree of prejudice and antagonism to the Petroleum Administration and the petroleum industry to a point where its labor policy subcommittee has been allowed to denounce as "a huge steal" the application for an urgently needed and long overdue readjustment in crude oil prices. Its ineptness in handling gasoline and fuel oil rationing has led to unnecessary discrimination between different sections of the country and has become an open scandal in some sections. Sweeping statements as to impending shortage and the early exhaustion of reserves have confused the public instead of informing it. The oft-displayed tendency of officialdom to shift responsibility and blame for its own mistakes and shortcomings to other shoulders threatens not only to put the oil industry in an unfair light but to thwart its efforts to serve the nation's needs with the greatest efficiency during the war emergency and in the post-war period.

The situation is analogous in many ways to that existing in relation to synthetic rubber in early 1942. At that time the claims of discrimination as to the processes and source materials to be employed in providing the country with an adequate supply of rubber substitutes, together with sharp differences between official agencies as to the allocation of materials, reached a point where it threatened the success of the entire synthetic rubber program. Reference of the matter to the Baruch committee resulted in a report embodying such a common sense analysis that it commanded universal acceptance. Its publication was followed by the appointment of William M. Jeffers to the post of Rubber Director and Mr. Jeffers proceeded, not without some friction and opposition, to carry out the program laid down by the committee with such a single-minded tenacity that he was able to relinquish his post a month ago with the announcement that the rubber program was well on its way to completion and was assured of success. In every complication that has arisen in connection with war activities since that time, including those affecting petroleum, proposals have been made for another Baruch report. The services which Mr. Baruch has rendered, voluntarily and in an unofficial capacity, have been effective in untangling many knotty problems connected with the conduct of the war on the home front.

The essential factors in petroleum's relation to the war effort have been fully developed in many studies and reports. There is less room for disagreement regarding them than there was in the case of rubber. An appraisal of the situation is not difficult and its value would lie in informing the public through an authority commanding public respect of the facts in the situation and the steps needed to insure the efficient functioning of the government's activities in this field. If it resulted, as in the rubber imbroglio, in the creation of a single administrative body to handle all governmental activities connected with oil, the consequences might be of immeasurable value to the country, its citizens, and its allies.

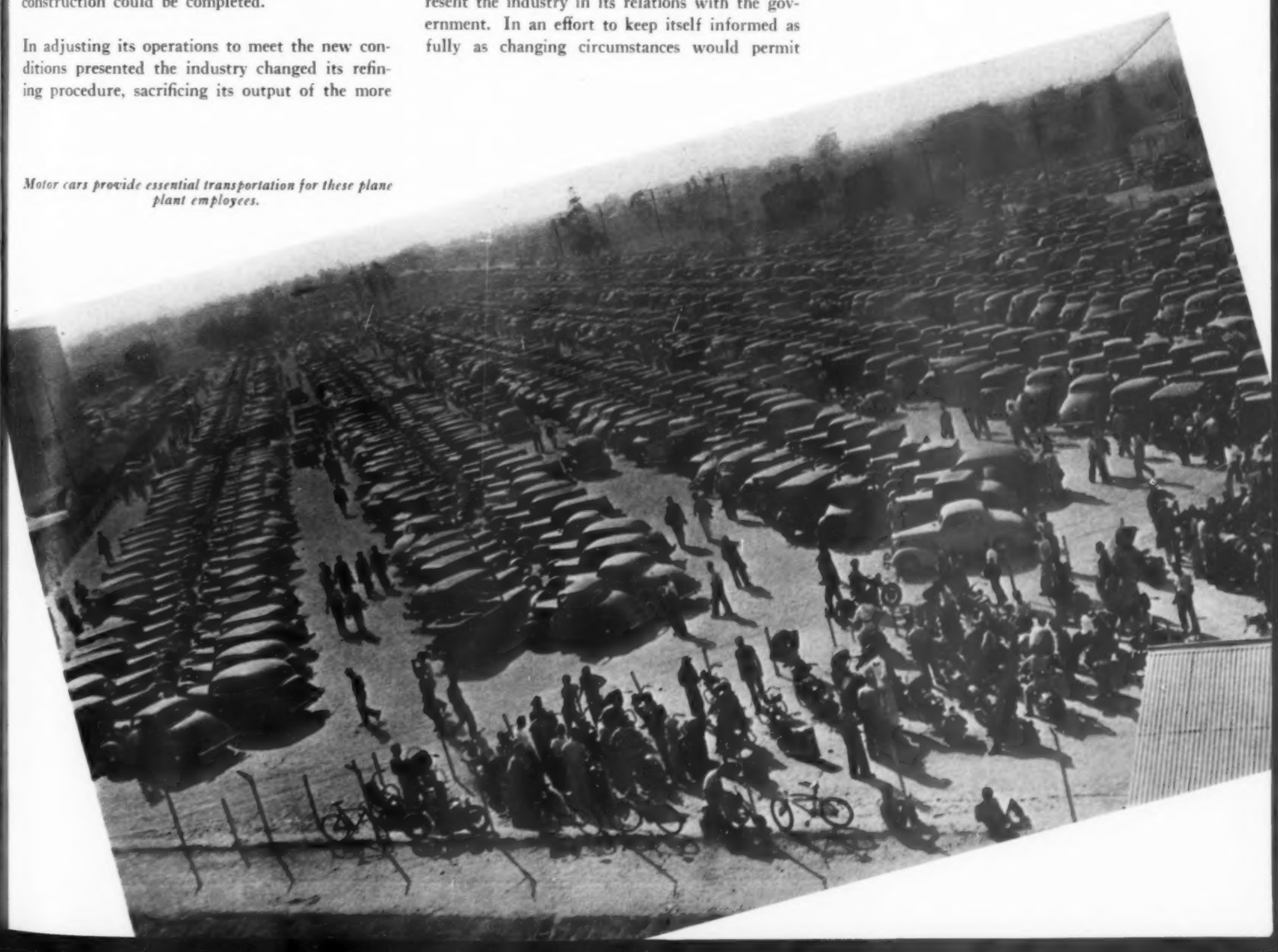
From the very beginning of the emergency period that preceded the actual outbreak of the war the petroleum industry has placed its facilities unreservedly at the service of the government. In the matter of military needs and products it asked only to be informed of the nature and extent of requirements and it has not failed to keep well in advance of demands no matter how unexpectedly and in what volume these have been presented. It has expended millions of dollars of its own funds in the provision of facilities for the manufacture of special war products and on research to improve these specialized products and the methods of obtaining them. Without these efforts and expenditures it would not have been possible to satisfy expanding military needs, especially in the critical period before war plant construction could be completed.

In adjusting its operations to meet the new conditions presented the industry changed its refining procedure, sacrificing its output of the more profitable products in order to increase the yield of others less remunerative. In compliance with official requests, it pooled products and processes, giving up trade advantages gained through long competitive effort. It joined in the effort to conserve critical materials by adopting substitutes and finding ways of employing used equipment in necessary plant construction. So far as its own initiative and activities were concerned, it is hard to find anything that the oil industry could have accomplished that it has left undone and, in fact, its achievements have drawn warm commendation from the Petroleum Administrator for War and from military authorities concerned.

In certain of its normal operations, however, the oil industry has been unable to exercise its customary freedom of choice. The prices of its products are arbitrarily fixed by the Office of Price Administration. Its drilling activities have been restricted by limitations imposed upon the use of steel and other structural materials. Thus, while the industry has had to meet extraordinary demands in the provision of certain of its products, it has been prevented from expanding its sources of supply to keep pace with this enlarged demand partly because of the scarcity of materials but largely because of the uneconomic price which removed the incentive for exploration.

When the United States entered the war, the Petroleum Industry War Council was established by the Petroleum Administrator for War to represent the industry in its relations with the government. In an effort to keep itself informed as fully as changing circumstances would permit regarding the supply and demand situation, the Council appointed various committees including a Committee on Economics, one of whose special tasks was to make estimates of future requirements and to study the means by which these could be satisfied. Since military demands could not be foretold with any degree of accuracy, the task of the committee has been a difficult one, but the reports which it has prepared from time to time have been of great value, and their forecasts have been remarkably accurate.

In successive estimates prepared by the committee the increasing difficulty of meeting war and lend-lease demands plus essential domestic requirements from available supplies in the United States has been pointed out repeatedly. In this connection the word "available" is important because it has a very direct bearing on the reports of an impending oil shortage. As used by the committee the word connotes the oil located in fields which are equipped with transportation facilities capable of moving their output to refining centres and points of distribution. Similarly, in presenting figures of production, the committee tabulates production from existing fields at the "maximum efficient rate", that is, the highest rate at which these fields can be produced without loss of ultimate recovery which might run to billions of barrels and deprive the country of oil that will be badly needed to meet future



Motor cars provide essential transportation for these plane plant employees.

Prentiss Brown, Chief of OPA.

demands. These are important factors affecting oil supply for the period directly ahead but they do not lead to the conclusion that the United States is running short of oil or will necessarily have to find substitute fuels to keep its industrial machine in operation.

Forecast of Supply and Demand

On this basis the report presented by the committee at the September meeting of the Council presents an instructive picture of the outlook for the final quarter of 1943 and the full year 1944 summarized in the following points:

1. The military requirements now indicated as being required from the United States, plus rationed civilian demand, and domestic industrial requirements, combine to confront the industry with a total demand which will be increasingly difficult to fill from domestic sources. As to gasoline, for example, war demands are presently taking about 31 percent of domestic output and this percentage is steadily increasing.

2. While the military requirements for gasoline have increased by more than 50 percent since January first and nearly 150 percent above the average of 1942, new transportation facilities have fortunately kept pace with this demand and no longer constitute a serious bottleneck. However, this unexpectedly large military demand, coupled with civilian gasoline consumption substantially in excess of that which gasoline rationing was designed to achieve, have combined to create a serious situation in that (a) Available domestic crude supplies will no longer be able to fill all the prospective demand heretofore assigned to this country, (b) Refining facilities in most parts of the country are approaching capacity, (c) Gasoline stocks have been drawn down at excessive rates in the country as a whole, and are at distress levels on the East Coast, (d) Higher crude runs, more use of heavy crudes and of less efficient refining units have resulted in unexpectedly large production and stocks of residual fuels, reversing the situation of last winter.

3. The resultant supply and demand estimates are probably best shown in the following table:

Projection of Foreseeable Supply, Domestic Ration Requirements and Military Demand and Apparent Deficiencies by Quarters, in Thousands of Barrels Daily

	1943	1944			
	4th Q	1st Q	2nd Q	3rd Q	4th Q
Foreseeable Supply:					
Crude Production (a)	4,289	4,268	4,321	4,398	4,366
Nat. Gas & Condensate	282	288	283	283	288
Benzol	2	2	2	2	2
From Crude Stocks	112	143	112	61	59
From Product Stocks (b)	107	147	(95)	(136)	(12)
Scheduled Imports	8	4	4	4	4
Total Foreseeable Supply	4,800	4,846	4,627	4,612	4,707
Total Domestic Ration Requirements and Military Demand	4,915	5,000	4,893	4,935	5,219
Apparent Deficiencies	115	154	266	323	512

(a) Maximum efficient rate except as limited by transportation.

(b) Figures in parentheses are accumulations, primarily of heating oils, to provide for domestic winter requirements.

4. The above indicated deficiencies occur even though all domestic fields not now producing at their maximum efficient rate are brought to that level as soon as possible, or as soon as transportation is provided from those producing fields not now sufficiently equipped with such facilities. Foremost among these fields are those of the Permian Basin in West Texas—New Mexico.

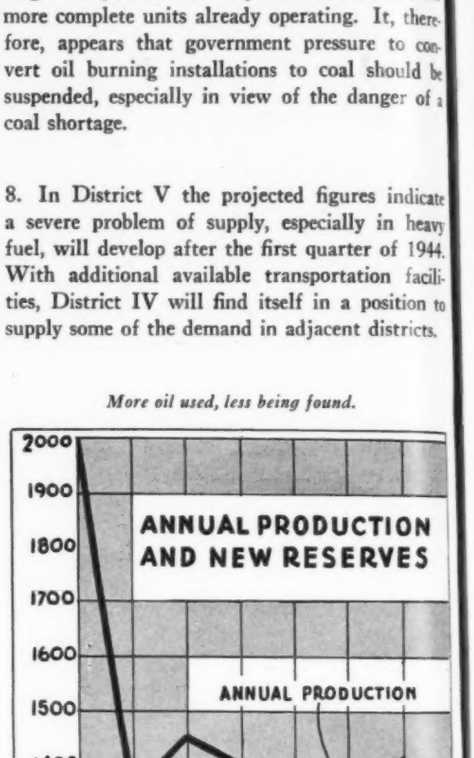
5. It will be noted that in the above table the supply credited to imports reflects only nominal amounts. To reduce the deficiencies indicated it will be necessary to increase imports and/or draw more of the United Nations' supply from foreign sources, if wasteful dissipation of this country's reserves is to be avoided.

6. In order that the deficiencies be no greater than those set forth, transportation and refining arrangements must be made for refiners to handle during the last half of 1944 about 240,000 barrels daily more West Texas high sulphur crude of which 54,000 barrels daily is scheduled for October, 1943; 90,000 additional in the second quarter of 1944, which represents part capacity of both the Stanolind and Magnolia Lines, and 35,000 barrels additional in the second half of 1944, representing the scheduled capacity of these lines. The remainder will then have to be moved through expanded capacity of then existing pipe lines, by direct tank car movement, or through new pipeline capacity.

7. Dislocation as between products will make it necessary for refiners east of the Rockies to adjust yields to make more gasoline, kerosine and distillate fuel, and less residual fuel. In many refineries this cannot be done without interference with war products of which heavy fuel is a necessary by-product. Also, the marginal refining units which are now having to be brought into operation in order to meet increasing demands, cannot in general produce as low yields of fuel oil as the more complete units already operating. It, therefore, appears that government pressure to convert oil burning installations to coal should be suspended, especially in view of the danger of a coal shortage.

8. In District V the projected figures indicate a severe problem of supply, especially in heavy fuel, will develop after the first quarter of 1944. With additional available transportation facilities, District IV will find itself in a position to supply some of the demand in adjacent districts.

More oil used, less being found.



9. The completion of various pipe line projects and the apparent easing of the tanker situation should permit the elimination of some of the more inefficient transportation operations, thereby contributing to the saving of manpower, rubber and gasoline, and reducing the burden on the railroads.

10. Inventories, except for residual fuel, are at, or near, minimum levels and cannot be depended upon to supply large portions of the demand after the first quarter of 1944.

11. In the light of the foregoing situation the necessity of avoiding wasteful or unnecessary use of petroleum products is apparent if we are to continue to meet the increasing demands of the military forces. There should be better public understanding of and support for measures designed to avoid wasting products which are so vital to the war effort.

12. In view of the very heavy demands for products projected for District V, the committee again urges that the development of the Elk Hills Reserve in California should no longer be neglected. These reserves are particularly rich in aviation gasoline and fuel oil so necessary for the prosecution of the war.

In the light of experience, this development can be conducted most speedily and efficiently by the oil industry rather than the government. Either the present negotiation, looking to unitization, should be promptly completed or the government lands should be leased by sections at public bidding subject to unitization. A prompt solution is important to the Pacific area.

As to crude oil production, the maximum efficient rate, (M.E.R.) has already been reached in most fields and probably exceeded in a few. The Permian Basin of West Texas, Elk Basin in Wyoming and Montana and the Naval Reserve at Elk Hills in California, are the only remaining areas from which substantial increases in supply may be expected unless new large fields are discovered and promptly developed. To exceed maximum efficient rates of production over any great period of time will result in dissipation of underground reserves. This must be avoided if at all possible.

The search for and development of new fields must be accelerated while production from many old fields must also be increased and the related problems of materials supply and manpower must be solved, if this country is to supply a larger portion of the oil needed than is shown in Table I.

The low price of crude oil is becoming more and more a retarding influence in the provision of adequate supplies of this raw material. The critical importance of petroleum in the war economy requires a favorable consideration of the repeated recommendations of the PAW for a price stimulus. An immediate increase in the discovery effort is necessary; additional secondary recovery projects should be commenced and steps taken to prevent premature abandonment of small wells. The low ceiling prices of crude oil in the face of greatly increased costs is generally recognized as the principal obstacle to obtaining adequate supplies of this raw material.

Estimates for July of this year show total crude oil production in the United States to have been approximately 4,108,000 barrels per day. Contemplated production during the second half of 1943 show the nation producing an average of 4,239,000 barrels daily with all districts running at about their maximum efficient rates, except District III. This area, however, shows an increase of 2,320,000 barrels average for the second half and 2,380,000 for the last quarter of 1943, against a July average of 2,194,000 barrels, and 1,880,000 barrels daily in 1942.

TABLE II

CRUDE OIL PRODUCTION STATISTICS

(Not including Natural Gasoline and Condensate)
Daily Average in Thousands of Barrels

District	1942 Year Average	1943 July Average	1943 Second Half		Year 1944	
			Contemplated Production	Estimated (a) M.E.R.	Contemplated Production	Estimated (a) M.E.R.
I	73	69	67	67	64	64
II	1,048	948	932	930	857	861
III	1,880	2,194	2,320	(b)2,570	2,497	(b)2,570
IV	114	123	126	124	125	123
V	680	774	794	795	794	794
Total, U. S.	3,795	4,108	4,239	4,486	4,337	4,412

(a) These are the M.E.R. figures used in Report XIV of the Committee on Petroleum Economics dated July 12, 1943.
Schedule "C", for Districts I, II, IV and V, which were there defined as "District Production Committee Estimates." For District III that report used PAW estimates in order to secure national totals. The above indicated figure for District III is that of the District III Production Committee.
(b) One year beginning May, 1943.

The major problems facing refineries in Districts I, II and III are: (a) handling increasing quantities of West Texas high sulphur crude oil rising to a total of about 240,000 barrels daily by the third quarter 1944; (b) adjusting yields to increase gasoline and distillate fuel oils and residual fuel oil.

There are various aspects to the West Texas crude problem:

(a) Many refineries are not equipped to handle West Texas crude, (b) special alloy steels are necessary to run high sulphur crudes because of corrosion, (c) additional transportation facilities must be provided out of West Texas. Depending upon the availability of tank cars, and the location of refineries equipped to run more high sulphur crude immediately, rail shipments out of West Texas should be made to Districts II or III. To use more of the needed refining capacity of District II by this method it is necessary to extend the plan for reimbursement of extra transportation costs to include this and similar movements into District II approved by PAW. This entire matter is one which requires the most careful study and attention from industry committees and the PAW before these additional runs of high sulphur crude can definitely be counted upon to supply more products.

PAW—Harold Ickes.

The present estimates indicate that gasoline and distillate yields should be increased and those of residual fuel oil substantially reduced. As was pointed out earlier, however, this cannot always be done without interference with war product production. This is one of the major problems confronting the refining branch of the industry at the present time as residual fuel oil yields east of the Rockies should be reduced by about 75,000 barrels per day.

One of the main factors contributing toward lower distillate yields is the large number of catalytic cracking units coming into operation. Many of these units will process distillate to make gasoline. It appears, however, that the yield of motor gasoline will continue at a low level, or even decrease as aviation gasoline production increases, although the total gasoline output will rise. Each barrel of aviation gasoline produced means the loss of more than one barrel of motor gasoline.

These findings of the Economics Committee were summed up a resolution adopted by the full Council and referred to the Petroleum Administrator for War:

"Today the United States is entering a period where it must be recognized that there is a shortage of petroleum and its products. This shortage is already causing serious restrictions on the civilian use of petroleum products. Unless some early action is taken to remedy the situation we must ultimately face further restrictions in essential civilian and industrial uses.

"The declining productive capacity is the direct result of an arbitrary and inadequate price ceiling, established and maintained contrary to the considered judgment of the petroleum industry and of the Petroleum Administrator for War to whom the President delegated the responsibility of providing adequate petroleum products.

"Realizing that the Nation's producible surplus was not sufficient to carry on a great world war and to supply essential civilian needs the Petroleum Industry War Council first reported on February 4, 1942, to the Petroleum Administrator that price ceilings on crude oil were inadequate to stimulate the necessary exploration and productive activity. As the war program developed the Council followed this report from time to time with other studies and recommendations to the same effect, particularly in October 1942, November 1942 and February 1943. Similar statements and recommendations have been made in the reports to the Council by the Economics Committee on many occasions.

"The Petroleum Administrator has vigorously and repeatedly recommended to the Office of Price Administration that the price ceiling on crude petroleum and its products be increased; his recommendations have been rejected by OPA and are now pending on appeal to the Office of Economic Stabilization, and no relief has yet been granted. The recommendation of the Petroleum Administrator for War for an increase in the ceiling price was made on a basis of an average minimum increase that then appeared necessary to encourage further production and exploratory activity. It was made long ago. Conditions have changed since the recommendation was made. Costs of production have further increased. Costs of exploration have further increased. In many instances it costs more to discover and produce a barrel of oil than the price now received.

"The Petroleum War Council again calls attention to the necessity for an immediate and substantial increase in the price of petroleum and its products. The situation has been permitted to become progressively worse. The inexcusable delay in granting proper price increases from the abnormally low level at which they were frozen has occasioned loss of manpower to other industries, loss of productive capacity, increased difficulties in the discovery and production of petroleum and accentuated restrictions on the use of its products for essential civilian and industrial needs. A price that might have been adequate months ago is now inadequate.

"The national interest is not now being properly safeguarded and remedial steps must be taken without further delay.

"Therefore, be it resolved that this statement be brought to the immediate attention of the Petroleum Administrator for War."

Factors Affecting Supply

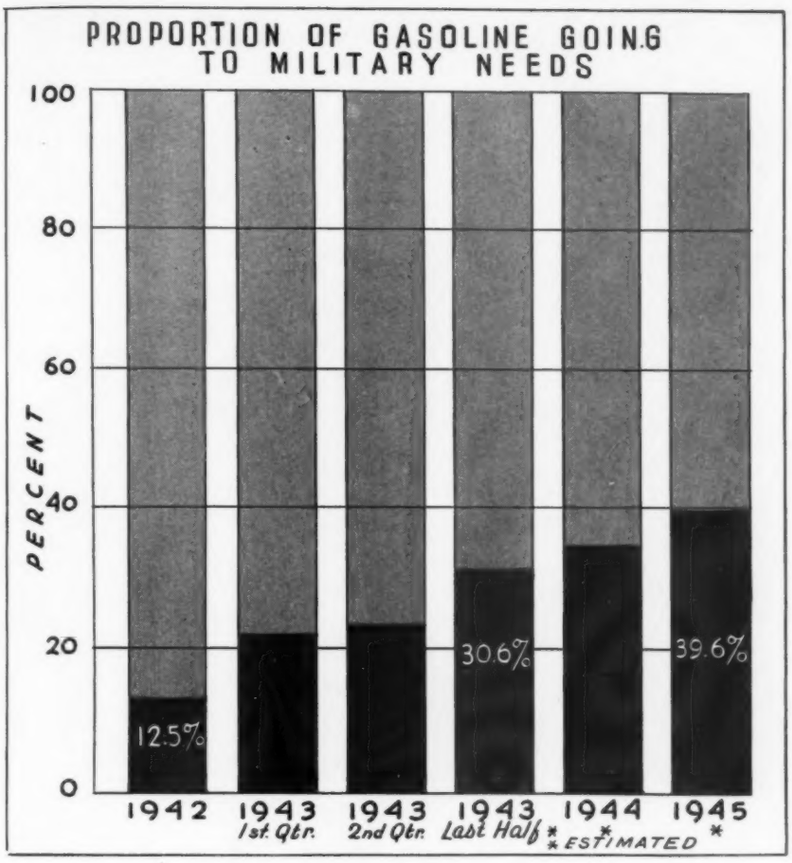
The report presents a realistic picture of the situation and shows a probable deficit rising to 512,000 barrels daily in the latter part of 1944, based on supplies from the United States to meet anticipated war uses and essential domestic requirements at the reduced rate of consumption now in effect. This would amount to nearly 20,000,000 barrels in the course of a year if no further increase in demand took place after December, 1944. Even to come as close as this to meeting requirements through American production assumes the utilization of supplies not now available for lack of adequate transportation and calls for the drilling in fields of known productivity which are still in the early stages of development.

One possible means of filling the prospective gap is by increasing the supply of oil from sources outside the United States. Only a nominal amount of oil is listed in the foreseeable supply under scheduled imports. In a previous report, however, the Committee had directed attention to the necessity for an immediate study of all sources of oil supply available to the United Nations in the various areas of crude production throughout the world. Statements by military authorities have made it clear that active measures to expand oil supplies from such sources are under way and indicate an expectation that as much as 500,000 barrels daily may be added to the petroleum resources of the United Nations from Latin America and the Near East. If the Committee forecast is accurate, however, this would accomplish no more than to meet a prospective deficit and, in the period before that full amount was obtainable, it might still be necessary to curtail further the civilian use of oil within the United States itself.

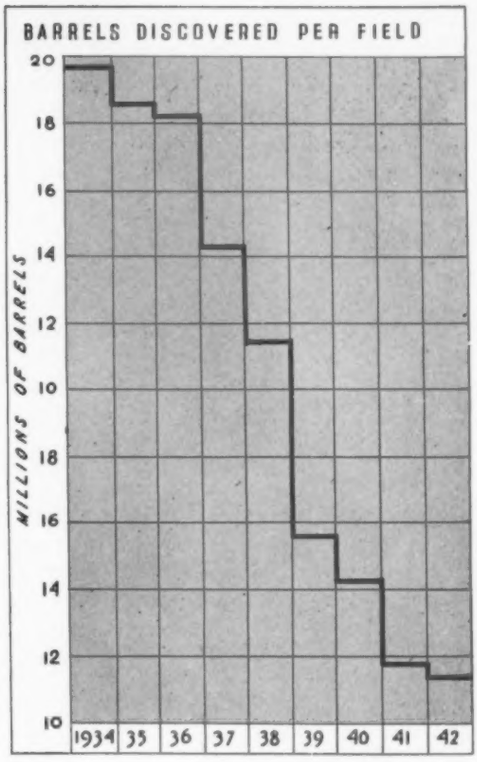
This raises the question of how domestic production can be increased above the level that marks the safe limit of output from existing fields. This is not a new question but one that has been widely discussed and intensively studied. It provides the real crux of the disagreement between the offices of Petroleum Administration and Price Administration. It is obvious that the only way to enlarge productive ability is by finding new fields through more extensive exploration and drilling. The oil industry maintains that the way to accomplish this is by establishing a price for crude oil which will encourage wildcat drilling. It points out that this is the historic method of expanding supply whenever it threatens to fall below current demand and that no effective substitute for it ever has been provided. The Petroleum Administrator for War, after careful study of the situation, agrees with this position and has repeatedly recommended an increase in the established price of crude which will make it possible for drillers and investors to expand the search for oil with a fair prospect of avoiding loss of the capital which they put into the effort.

Here is where an impasse arises. The Petroleum Administrator, while charged by the President with "the development and utilization with maxi-

K. T. Compton, J. B. Conant and Bernard Baruch, the Baruch Rubber Committee.



War absorbs increasing share of nation's oil.

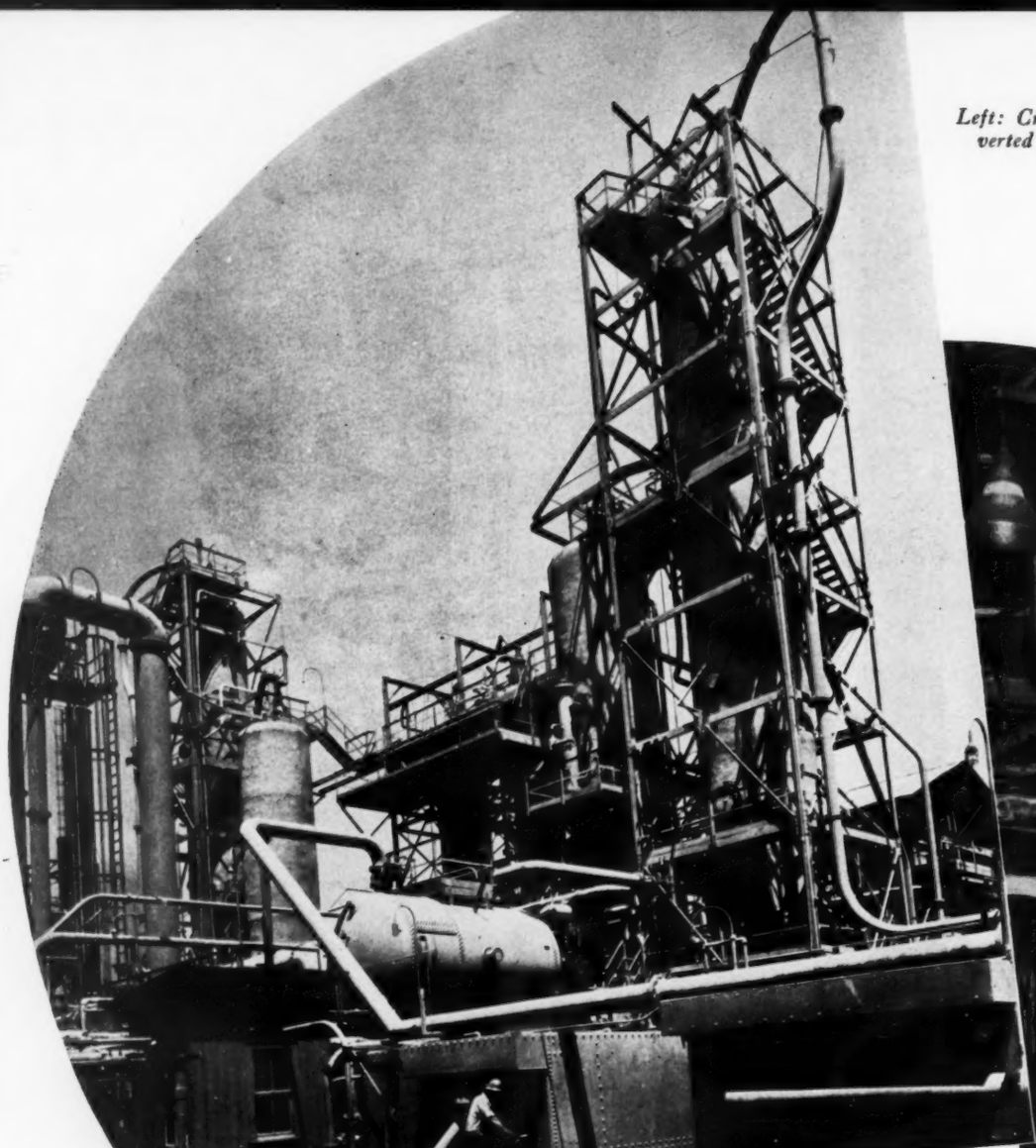


New fields discovered are decreasing in size.

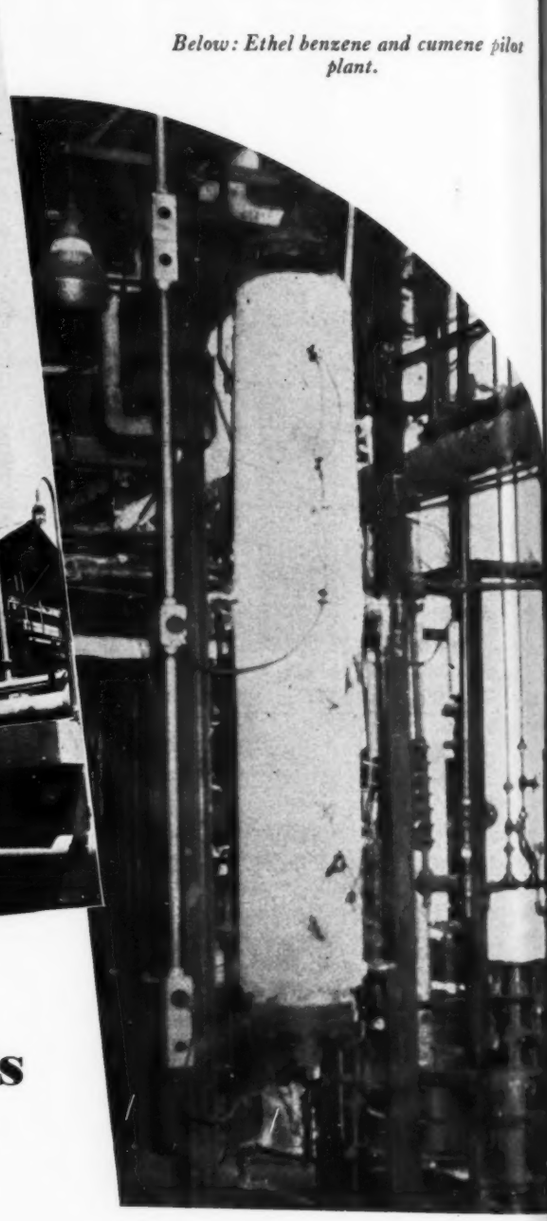
mum efficiency of our petroleum resources and our facilities, present and future, for making petroleum and petroleum products available adequately and continuously in the proper forms, at the proper places and at reasonable prices to meet military and civilian needs", has no actual authority over conditions essential to the accomplishment of this result. Authority to determine the price of oil rests in the hands of the Office of Price Administration, an entirely independent and non-co-operative government agency. For more than two years the Office of Price Administration has turned a deaf ear to repeated applications from individual oil companies, from associations representing every branch of the industry and from the Petroleum Administrator for War, asking for a readjustment in the existing price which has remained at the abnormally low level prevailing in 1941. It has disregarded studies and statistics showing that the price of oil is much below the level of other commodities, that costs of operation have increased and that, as a result, not only have the normal additions to reserves in new fields been lacking, but thousands of small wells have been closed down because they can no longer be operated except at a loss. Not only has the Office of Price Administration maintained this stubborn attitude, but it has failed to propose any other measure of relief except for vague suggestions of a federal subsidy for drilling and for maintaining production in high cost wells. The proposals are regarded by oilmen generally and by petroleum economists as entirely impractical in application and likely to lead to serious abuses. As a result of this divided authority, the Petroleum Administrator for War has been handicapped in carrying out the President's directive in regard to the development of petroleum facilities with maximum efficiency to meet military and civilian needs. Effort has been concentrated necessarily upon providing full supplies for military requirements with a result that the civilian economy has had to suffer even to the point of affecting war production activities. Another way in which divided authority has seriously affected the provision of oil supplies for industrial needs has been in the matter of rationing. One of the powers of the Petroleum Administrator is to determine the amount of oil that can be made available for domestic use after military needs and the requirements for Lend-lease have been met, but the allocation of these supplies to different sections and different classes of consumers rests with the Office of Price Administration. The manner in which this function has been administered by the Office of Price Administration has aroused wide-spread criticism and public dissatisfaction. The statements made by the two agencies as to available supplies and allotments often have been at variance and this in turn has contributed to confusion in the minds of the public as to the actual situation and as to the necessity of some of the measures adopted.

It has long been the opinion of those familiar with the situation that efficient administration of petroleum affairs could only be realized through the establishment of unified governmental authority in the hands of a single agency. This feeling has expressed itself in many urgent requests for the centralization of such authority in the Office of Petroleum Administration but no action in this direction has been taken as yet.

It is recognized that war needs for petroleum products must be fully and promptly satisfied regardless of all other considerations. Any deficiencies in supply must be met by restrictions on the use of petroleum products within the United States. From present indications, and with the present organization of government regulation, there is little prospect that these restrictions will be eased until after war activities have passed their peak. Whether existing regulations are equitably applied is a subject of sharp dispute. The need of increased activity in exploration and drilling, in order to add to known reserves and production, is becoming rapidly more urgent. These are matters on which there is hopeless disagreement between government agencies concerned and consequent uncertainty and dissatifaction among the consuming public. The existence of this state of affairs and its threat to the future progress and welfare of the country is the basis and justification for an inquiry which will put the facts clearly before the American people.



Left: Cracking coils that have been converted to the production of butadiene.



Below: Ethel benzene and cumene pilot plant.

TECHNICAL ADVISORY COMMITTEE'S WORK HAS VASTLY AIDED WAR PROGRAM

Working quietly behind the scenes, a group of men who represent the most advanced thought and progress in refining research and development has rendered a service of the highest importance in enabling the industry to meet unanticipated war demands. Their work has made it possible to supply the armed forces of the United Nations with super fuels even before the plants designed especially to provide such products were in operation. Through teamwork and cooperation, replacing former competition, the technical progress of the refining industry has been carried forward even more rapidly than in peacetime. Theirs has been an industry effort financed by the companies concerned and operating as an arm of the Petroleum Industry War Council, though working closely with the Petroleum Administration for War. In releasing the information contained in the accompanying account, William R. Boyd, Jr., Chairman of the Petroleum Industry War Council, aptly characterized it with the statement, "The story of aviation gasoline, when the history of this war is finally written, may well be cast as the supreme triumph of American industry, the preeminent achievement of the ingenuity, resourcefulness, and downright sheer wizardry of the scientists of the petroleum industry."

CREDIT for the war-time refining achievements of the petroleum industry is shared by the oil companies, the Petroleum Administrator's staff, the Aviation Gasoline Advisory Committee, and many others, but one of the agencies responsible in large measure is the seldom-mentioned Technical Advisory Committee of the Petroleum Industry War Council. This group of scientists, representing a cross-section of research organizations in the petroleum industry, was formed in October, 1942, to correlate the research and development on petroleum war products under the direction of the Council and in collaboration with the Petroleum Administration.

The volume of research in petroleum has been one of the astounding developments of the past decade. Before the war, according to a number of surveys, no other industry could match its progress. Every large oil company has its staff of scientists, and smaller companies command the brains and services of several large organizations which specialize in petroleum research. Altogether more than 5,000 scientists have been working to find new uses for petroleum, to make present products better. In one decade the petroleum industry virtually has been transformed into a chemical industry.

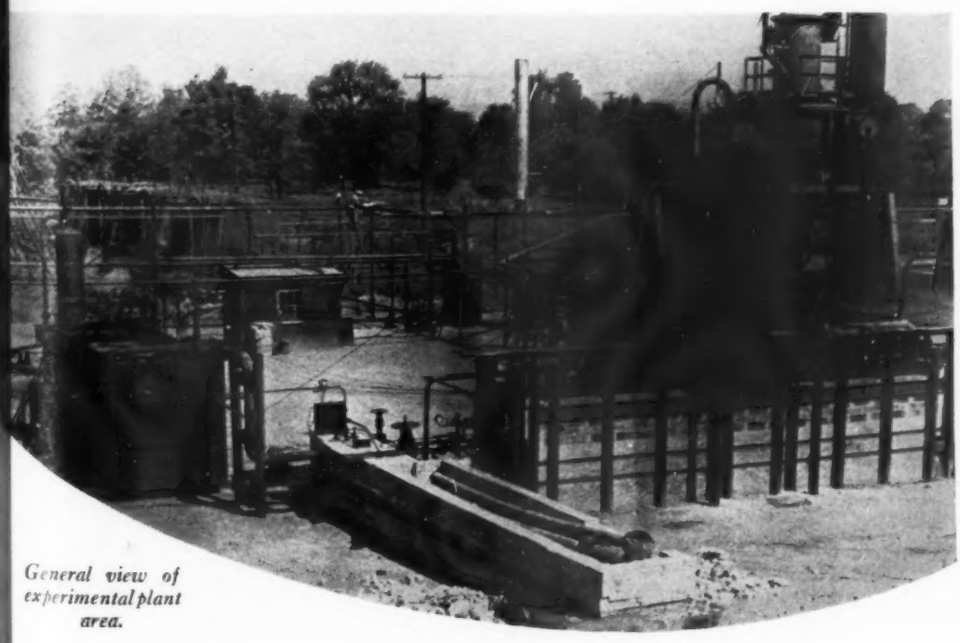
That is the research team which has been harnessed in the Technical Advisory Committee (TAC) to perform the necessary miracles to help accomplish the impossible in war production of petroleum products. Many of the accomplishments of the TAC cannot be known until after the war. Secrecy applies to research and advances in operating methods just as much as it does to munitions production and troop movements. But some of its achievements and the manner in which it operates can be described.

Early in 1941 some conception of the huge future demand for super aviation gasolines was evident. The refineries already making 100-octane gasoline and those scheduled for completion by the end of 1941 could produce a little more than 40,000 barrels, or about 1,750,000 gallons, a day. Though at that time the petroleum industry for lack of orders was unable to operate even these plants at full capacity, Petroleum Administrator Harold L. Ickes and industry leaders recognized that the future surely would bring demands that could not be met with these plants. The obvious answer was more plants, and by the middle of the year the groundwork for a program of new construction was laid down. But new plants, as complicated and as prodigal of critical materials as are 100-octane units, cannot be built overnight. None of them was completed on December 7, 1941, when war brought a crisis to all production programs.

In the emergency the 40,000-barrel capacity was jumped overnight to almost 50,000 barrels a day by the simple expedient of increasing the permissible content of tetraethyl lead from 3 cc to 4 cc per gallon. But that was then believed to be just about the top production possible from the existing plants; any further increases would have to await the completion of the new units, those that had been planned previously plus a building program that has been expanding continually ever since.

The war could not and would not wait, however. Miracles were necessary. And in the eighteen months since Pearl Harbor the oil industry's scientists have accomplished those miracles, sweating more aviation gasoline drop by drop, gallon by gallon, from the existing plants.

The methods used have been many, because fortunately super aviation gasoline is not one product, but may be any one of several. Basically it is a blend of selected hydrocarbons: a high-grade base stock gasoline, a high-octane blending agent —such as hydrocodimer, alkylate, cumene, or some equivalent—isopentane, and tetraethyl lead. Any one of a number of combinations of these constituents makes high-octane aviation fuel, and the work of the scientists has been to discover new ways of making increased proportions of the known valuable constituents and to discover new ones that can be substituted to increase production or raise the quality, largely by using existing refining equipment.



General view of experimental plant area.

Whereas before the war each manufacturer of 100-octane gasoline had what was essentially an integrated operation in his own plants, the emergency brought a new conception—the integration of all the refineries and natural gasoline plants in the country that could contribute in any way to its production. As a result, refineries that never thought of themselves as manufacturers of aviation gasoline now make one or more of the constituents—codimer, perhaps, or cumene, or alkylate, or even some of the raw material hydrocarbons like isobutylene which are a first step in the manufacture of the blending agents themselves.

Each plant makes what it can, and ships it to another refiner for further processing or for blending. Thousands of tankcar loads have moved and are still moving from one refinery to another in a highly integrated interplant combine that is pushing aviation gasoline production to constantly greater peaks.

Thus, even before new plants could be built, the petroleum industry has come through with many times the quantity of aviation gasoline that anyone thought possible eighteen months ago. Perhaps even more important, the average quality has jumped much beyond the pre-war level of "super" 100-octane. And when it is realized that every small increase in octane number automatically decreases the overall productive capacity, the job that has been accomplished seems even more astounding.

Petroleum Administrator Ickes has paid tribute to these achievements many times, and recently he quoted an Army general: "The job which has been done with 100-octane by the refinery experts of your staff and of the oil industry is one of the most amazing things I have ever witnessed. It is almost unbelievable. They have virtually squeezed it out of a hat."

The role of the TAC in this amazing achievement has been that of collector, correlator and disseminator of the information which showed the individual plant operators what could be done with their equipment. Many of the things it has done were, of course, being done on a limited or uncorrelated basis, by the oil companies themselves, and through the advisory supervision of the Petroleum Administration. But since the TAC has assumed responsibility under the direction of PAW, the volume and direction have increased enormously.

In the spring of 1942 aviation gasoline, politics, and even the war were momentarily forgotten in a great nation-wide furore about synthetic rubber. The whole story is too long and too widely published to be retold here, but it was that controversy which was responsible for TAC.

A large-scale program of synthetic rubber plant construction which was originally approved had as its major part the manufacture of butadiene

from petroleum and alcohol, the manufacture of styrene, and the copolymerization of these two main ingredients into Buna-S.

In scheduling construction of the new plants it was anticipated that much of the styrene capacity would be completed well in advance of the matching butadiene plants, and that the program would be out of balance for some time. Because the oil industry naturally was vitally concerned in the success of the program, the PIWC had appointed a committee on synthetic rubber, and it named a working sub-committee of technologists to see what might be done to meet the anticipated emergency.

This group, the Technical Advisory Committee of the Committee on Synthetic Rubber, rapidly canvassed the existing refining capacity of the industry and the methods of manufacturing butadiene from petroleum, and, in collaboration with the PAW, proposed a large-scale refinery conversion program to make "quick butadiene." The committee also, as mentioned later, delved into the use of isobutylene for Flexon butyl rubber, and into the manufacture of ethylbenzene for styrene.

The "quick butadiene" program contemplated the use of only small quantities of critical materials to convert existing refining equipment to the production of butadiene along with normal petroleum products, more or less as an emergency measure to bring the butadiene time table into jibe with the styrene schedule. However, a number of the new butadiene plants were coming along faster than expected and a considerable part of the program as developed by the Committee was deemed to be unnecessary.

The original purposes of the TAC, therefore, had been accomplished, and its reason for existence, to help meet a particular emergency, virtually had disappeared. However, its work in the specialized field of synthetic rubber had produced a number of corollary discoveries that pointed to an even more valuable function as an integrated research and development body for all petroleum war products, and in particular for all-important aviation gasoline.

In the first place, when the possibilities of refinery conversions to make butadiene were being explored, it became increasingly apparent that this same method could be used even more widely than it was to increase the production of other vital war products, especially aviation gasoline. In fact, it was obvious from the start that the conversions to make butadiene had an automatic effect on the production of other products, and that the needs of all programs had to be judged together.

In the second place, as a central voluntary group of oil men, the TAC provided a direct liaison for the refining staff of the PAW with the research and development branches of the entire petroleum industry, a working arrangement that could be set up in no other way. To effect this correlation, in October, 1942, William R. Boyd, Jr., chairman of the Petroleum Industry War Council, appointed a technical committee with Dr. Robert E. Wilson, president of Pan American Petroleum & Transport Company, New York, as chairman, and, with R. H. Colley, president of The Atlantic Refining Company, Philadelphia, and W. S. S. Rodgers, president of The Texas Company, New York, as members, to supervise the activities of a new technical advisory committee to be appointed with the older rubber committee as a nucleus.

Since then the TAC, with Dr. T. G. Delbridge of The Atlantic Refining Company as chairman, and K. G. Mackenzie of The Texas Company as secretary, has expanded its membership and its activities widely, and is today a spearhead and clearing-house of the oil industry's research and development activities on several petroleum war products. The twenty members of the committee are from all parts of the country, and as far as is known every oil company which has research and development facilities that can be of assistance in its work is represented on the TAC.

The main committee meets about six times a year, but the work is directed continually by the smaller executive board, meeting every two weeks, and by Albert E. Miller, of the Sinclair Refining Company, secretary of the executive board and a member of each of the subcommittees, who is in full-time charge of the committee's staff.

All projects come to or through three active working subcommittees: Analysis, Harry Levin, The Texas Company, chairman; Primary Processes, P. J. Harrington, Standard Oil Development Company, chairman; and Synthesis, H. W. Field, The Atlantic Refining Company, chairman. Many reports of the latter two subcommittees go through the Correlations Group, under W. E. Chalfant of Atlantic, which sorts out the various reports and puts them together as a unified whole. Mr. Miller, as a member of each of the subcommittees, acts as a coordinating member so that everyone will be continually informed of what all others are doing. Through weekly contacts with the refining division of PAW he keeps the committee groups and the PAW aware of all developments as they occur.

The actual office expenses of the committee are paid by the oil industry itself through the PIWC, but all of the time of all individuals in these many groups is donated by their companies.

The work of TAC as an entirely voluntary industry organization is nominally under the direction of the PIWC and its technical committee on broad matters of policy. In its day to day activities, however, its close working relationship is with the refining division of PAW, which presents research and development problems to the TAC for assistance.

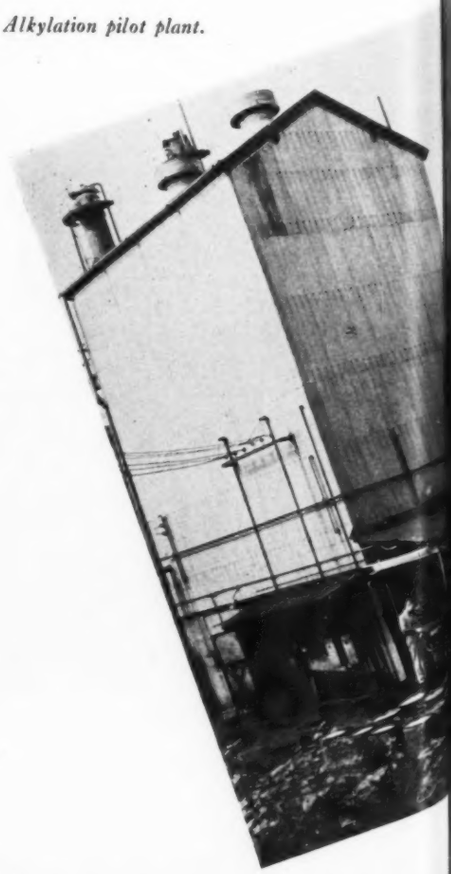
Broadly, its declared functions are "to conduct or promote voluntary cooperative research and development work in the fields of manufacture and utilization of petroleum products for war", with these specific duties:

(1) To collect and correlate available basic technical information;
(2) To obtain when needed further information through voluntary research and development work utilizing laboratory, pilot unit, or full scale plant equipment;
(3) To transmit such information to the Petroleum Administration for War and to such other government agencies and individuals as shall be specifically designated by the Petroleum Administration for War.

Under this arrangement the TAC issues two principal types of reports: Digests of a number of reports and all available information on certain broad subjects, such as alkylation, in which are also included data developed specifically for the committee to fill gaps which become apparent when the reports are correlated; and separate reports of individual companies which are reproduced and issued by the committee "as is."

The specific subjects which are studied by the committee and the distribution of its reports are governed by the PAW. Within these broad but specified limits, the TAC receives reports from all petroleum research organizations and from many outside organizations, companies, and individuals, correlates the data on similar subjects in its Correlation Group, studies the data in its subcommittees, requests assistance from any research organization which has the proper facilities and personnel to undertake investigations to

Alkylation pilot plant.



fill in missing data, and digests the entire mass of information into comprehensive reports which are directly applicable to refinery operation.

The work of two or more companies on the same or similar subjects can thus be evaluated, combined, and correlated so that duplication of research is held to a minimum, and missing parts of research and development puzzles are readily apparent. Often other companies, qualified by equipment, personnel, or some other reason, are asked to study problems not their own to fill in missing pieces. In the same way, methods which look good in the laboratory stage are tested in pilot plants, those that appear to be valuable in the pilot plant are tested in full plant operation, wherever the facilities exist to do the job most efficiently.

All of the research data are contributed voluntarily to the common pool, regardless of the cost to the original owner. In no instance has any information been refused, the committee reports. In one four-month period last year, when the synthetic rubber research was being conducted, more than a million dollars was voluntarily spent by the participating oil companies in research for the committees.

The same working relationship is carried on with chemical, construction, and other organizations and individuals outside the petroleum industry which may have pertinent research data to help solve petroleum research and development problems. Many such companies and institutions have volunteered highly important information to the petroleum war effort through TAC.

So far the major part of the work of TAC has been in synthetic rubber many problems of which are still being investigated, despite the ending of the "quick butadiene" emergency and in aviation gasoline. However, the set-up of the committee is such that it is instantly available to help solve any research and development problems of petroleum war products, and it is expected that its activities will be broadened as these problems arise.

One of the best concrete examples of the way in which the TAC works is its continuing study of alkylation. This dates back to its original synthetic rubber study, for part of that investigation was concerned with Flexon, the butyl rubber, the raw material for which is isobutylene.

But isobutylene is also a prime olefinic raw material for alkylation into high-octane blending materials for aviation gasoline, and TAC could not recommend its use for rubber unless it could also offer substitutes. This led to a study of the increased use of other olefins, such as amylene and propylene, both in sulfuric acid and hydrofluoric acid alkylation.

TAC therefore set to work to assemble everything known about both types of alkylation in one comprehensive report. This revealed that there were a large number of gaps in the known data and several companies were asked to go to work at top speed to fill in those gaps.

All of this work was done through the Synthesis subcommittee, but the study soon became so broad that both of the other subcommittees were called in. It was not enough to emphasize, as the Synthesis subcommittee's reports did, that the other olefins could be alkylated successfully. Their use was so new that very little was known either about methods of identifying, making or purifying them in normal refinery operations.

The first problem was assigned to the Primary Processes subcommittee to develop methods of manufacturing these other olefins in ordinary thermal cracking and fractionating facilities; the second was given to the Anayltical subcommittee to find an answer, for obviously no refiner could be asked to manufacture something he could not identify.

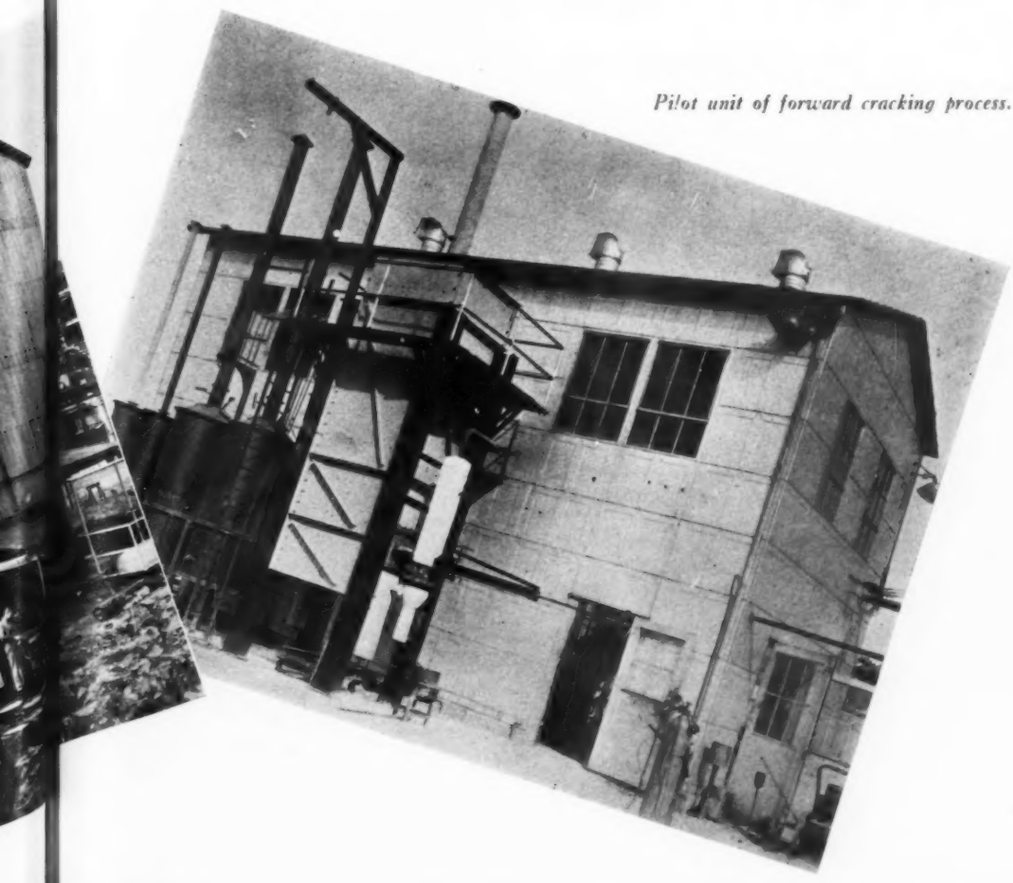
Together the three subcommittees developed methods of analysis and manufacture of olefins, and better methods of synthesis in alkylation which have been introduced in many refineries and have contributed immeasurably to the production of aviation gasoline. Unfortunately war secrecy prohibits the publication of production figures which would reveal the tremendous increases in alkylate manufacture. Even were it possible to give these figures, it would be extremely difficult to assess the contributions of the TAC work in comparison with those of other groups which have helped, but there is no question that millions of gallons of aviation gasoline now being burned in Allied planes all over the world were made possible by its studies.

Also as part of its rubber investigations TAC early undertook the study of the manufacture of ethylbenzene, a product of the utmost importance in the manufacture of styrene for synthetic rubber. Oil industry research already had indicated a possible solution to the problem of making ethylbenzene from alcohol, and TAC investigations in the laboratory proved that it could be made by the modification of a petroleum refining process.

This method was tested in plant operation and proved workable. Now it is being used on a commercial scale for the production of ethylbenzene at an Ohio plant.

When TAC undertook research and development in aviation gasoline this early experience with ethylbenzene became extremely valuable because the same type of plants which were studied for ethylbenzene, the dozens of poly units scattered over the country, were the units best equipped for the production of codimer, now a most important raw material for high octane blending stocks.

Although research had demonstrated the value of codimer, production was comparatively small. Today it has become a very important source of high octane material. TAC has been of constant help, ever since it was organized, in increasing production of codimer in plants already producing it, and in demonstrating to other plants how it could be made by slight changes in refinery operations or by small conversions of existing facilities. A number of plants which have adopted the TAC methods have more than doubled codimer production.



Pilot unit of forward cracking process.

Other codimer studies revealed the relative value of using it as a feed stock for alkylation, or of hydrogenating it to hydrocodimer. From these studies it was possible to reshuffle some operating programs, shipping codimer to hydrogenation plants that had excess capacity, and releasing alkylation capacity for other raw materials.

The committee's work with aromatics has also been of great importance in the rise of aviation gasoline production and quality. Most of the low-carbon alkyl benzenes are highly useful as high octane blending materials, and TAC has done and is still doing a great deal of research and development with them. Cumene, of course, is the most prominent example.

Altogether it is not too much to say that the work of TAC on alkylation and codimer production, and its subsequent study of aromatics, have been of inestimable value in the production of aviation gasoline, and have made possible to no small degree the almost incredible increases which have been achieved with existing facilities. These same discoveries, of course, have been used to modify or change the new plants as they are being built, so that their actual capacities will be much greater than those for which they were designed.

In all of its studies on aviation gasoline TAC has worked closely with the PAW Aviation Gasoline Advisory Committee which is a voluntary group of petroleum industry experts appointed in their individual capacities directly by PAW. AGAC, made up essentially of refinery operating men, operates much like a manufacturing department of PAW, while TAC has many of the functions of a research and development branch.

Since it first began working, TAC has distributed 164 reports to mailing lists some of which run as high as 650, depending upon the nature of the reports and instructions from PAW as to their distribution. In the month of June alone nineteen reports were prepared and distributed by the committee.

The reports are used directly by the refinery operators to whom they are sent, and are of particular value to the AGAC. Through AGAC the correlated information developed and supplied by TAC is carried directly to the refineries that can use it.

The Primary Processes and the Synthesis Subcommittees so far have considered as source material more than 250 individual reports from research organizations, and the Analytical Subcommittee has made use of hundreds of reports.

Because its work deals for the most part with new processes of individual oil companies which must be classified as military secrets the distribution of TAC reports varies according to their nature. By direction of the PAW, distribution of reports is made only to those who can use the information for the prosecution of the war effort.

The membership of the TAC represents a cross section of the petroleum industry's extensive and able scientific personnel.

The membership of TAC is made up of the following individuals, each of whom has an alternate from his company:

T. G. Delbridge, *Chairman*	The Atlantic Refining Company
K. G. Mackenzie, *Secretary*	The Texas Company
Eugene Ayres	Gulf Research & Development Company
D. E. Carr	Union Oil Company of California
D. E. Day	Richfield Oil Corporation
R. A. Halloran	Standard Oil Company of California
H. Y. Hyde	Tide Water Associated Oil Co., Inc.
E. W. Isom	Sinclair Refining Company
W. W. Lowe	Cities Service Oil Company
E. B. McConnell	The Standard Oil Company (Ohio)
Walter Miller	Continental Oil Company
L. W. Moore	Pan American Petroleum & Transport Co.
G. G. Oberfell	Phillips Petroleum Company
A. E. Pew, Jr.	Sun Oil Company
D. Pyzel	Shell Oil Company, Inc.
J. B. Rather	Socony-Vacuum Oil Company, Inc.
J. K. Roberts	Standard Oil Company of Indiana
W. B. Ross	The Pure Oil Company
R. P. Russell	Standard Oil Development Company
H. D. Wilde	Humble Oil & Refining Company

The Executive Board is composed of the following:

T. G. Delbridge, *Chairman*	E. W. Isom
Albert E. Miller, *Secretary*	K. G. Mackenzie
H. W. Field	Max Neuhaus
P. J. Harrington	J. B. Rather

Chairmen of the subcommittees have already been named earlier in this article.

NOW'S THE TIME TO DRIVE FOR WAR BOND SALES AS YOU NEVER DROVE BEFORE!

Many a soldier owes his life to a commander who drove him to the utmost in battle—*never let him slacken for a single fatal instant!* And after the war, many a worker will owe his economic safety to a leader who drove him continuously for higher Pay-Roll allotments for the purchase of War Bonds!

Despite higher taxes and prices, the average worker still has more money than ever before—particularly on the basis of the *family* income. With others in the family earning, too, just let the worker 'figure it out for himself', and he usually will realize that *now* he can put more into War Bonds than he has been doing.

That's why the Treasury Department has set new quotas for the current Pay-Roll Allotment Drive—*quotas running about 50% above former figures.* These quotas are designed to reach the *new* money that's coming into the family income. Coming from millions of new workers . . . from women who never worked before . . . from millions who never before earned anything like what they are getting today!

The current War Bond effort is built around the *family* unit, and the Treasury Department now urges you to organize your War Bond *thinking*—and your War Bond *selling*—on the basis of your employees' *family* incomes. For details, get in touch with your local War Finance Committee which will supply you with all necessary material for the proper presentation of the new plan to your workers through your labor-management committees.

Today about 30,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. Great as this sum is, *it is not enough!* So turn-to today! Get this new *family income plan working!*

This Space Is a Contribution to America's All-Out War Effort By WORLD PETROLEUM.

TRIPTANE MADE AVAILABLE AS PETROLEUM WAR PRODUCT

LATEST addition to the list of super fuels developed as a result of research directed to increasing the power and efficiency of petroleum production for war is announced by the Universal Oil Products Company. This is a method of obtaining triptane which makes it possible to produce it in quantity and at a cost which is not prohibitive. Thereby a new and important weapon is provided for the nation's military use in a product that may prove of future great commercial value.

Triptane is not new but, heretofore, has remained a laboratory curiosity. It is rated as the most powerful hydrocarbon known for use in internal combustion engines. Its antiknock properties are of such magnitude that no commercial engine has been built which is capable of utilizing the full power value of pure triptane. When used as a component of aviation gasoline, it greatly enhances the performance of present-day aircraft engines and makes possible the design of future engines of even greater power and efficiency.

Although its existence has been known for years and some of its physical properties have been determined, triptane has been a laboratory product because the known methods of producing it involved the classical but impractical Grignard reaction, or zinc di-methyl as a reactant. Reported costs for producing triptane in very small amounts in the laboratory by these methods have run as high as $3,000 per gallon. More recently it has been stated that several hundred gallons of triptane produced within the past two years for experimental purposes involved an expenditure of $40 per gallon. Even if the cost had not precluded the use of triptane for war purposes, the consumption of critical materials needed to produce it by previously known methods would not have justified its production.

Dr. Vladimir Haensel

To make triptane in large quantities by practical methods was heretofore considered impossible. Two American scientists, however, were undeterred. Dr. Vladimir Haensel, research chemist, and Prof. V. N. Ipatieff, director of chemical research of the Universal Oil Products Company, working with materials at hand and available in quantity, made the discovery which makes possible commercial production of this amazing fuel.

Haensel and Ipatieff, together with Universal's technical staff, make possible the production of triptane at an estimated selling price of less than one dollar per gallon. Their discovery removes this magic hydrocarbon from the shelf of the chemical museum, making it available as a powerful war-time weapon. Thus American enterprise which first taught the world how to fly, is maintaining its pace as the leader in giving the United Nations the most powerful fuels with which to fly.

The process consists of two steps. The second step of the process involves the formation of triptane from a selected charging stock produced in the first step. Based on the material charged to the second step, recoveries of over 90 percent are obtained with over 50 percent triptane.

The process, when operated to make the largest quantity of triptane available as a blending agent, yields two other valuable hydrocarbons, in themselves of great value in aviation blends. These hydrocarbons, 2, 3-dimethylbutane and 2, 3-dimethylpentane, are superior to alkylate as blending agents for aviation gasoline.

The following are physical properties of individual hydrocarbons produced by this process:

Compound	B.P., °C	M.P., °C	Refractive Index. nD^{20}	Specific Gravity
2, 3-dimethylbutane	58.0	—128.8	1.3750	0.6620
2, 2, 3-trimethylbutane (triptane)	80.8	—25.0	1.3894	0.6901
2, 3-dimethylpentane	89.7	.....	1.3920	0.6944

The relatively high freezing point of pure triptane does not preclude its use in aviation fuels. Blends containing up to about 85 percent triptane do not freeze above —78° C. (—108° F).

The product of the reaction is saturated and free of impurities so that no additional refining treatment is necessary to permit its use in aviation fuels. The process has been operated to date for 300 hours in a pilot plant with no indication of decline of catalyst activity.

No new or unusual materials are needed for the reaction or process. The raw materials are condensable gases produced in petroleum refineries as by-products of catalytic and non-catalytic cracking or reforming of petroleum oils. The catalysts are readily available in large quantities. No special equipment or materials used in the process plant are necessary other than regular equipment employed in refineries. The temperatures and pressures employed are well within refinery experience.

Dr. Vladimir Haensel, who, with Dr. Ipatieff, is responsible for this development, is only 28 years old. He is employed as a research chemist by Universal Oil Products Company. He has a Bachelor or Science degree from Northwestern University, and a Master of Science degree in chemical engineering from Massachusetts Institute of Technology. He received a Doctor of Philosophy degree in chemistry from Northwestern University in Evanston, Illinois, where he was the first Ph. D. of Prof Ipatieff's in this country working in the newly established high pressure catalytic laboratories.

Prof. V. N. Ipatieff is internationally known to the oil industry as the discoverer of numerous catalytic reactions and processes. In World War I, he was a general in the Russian Army in charge of chemical industries. In this, his second World War against Germany, he is an American citizen and has scored again against his old enemy. Processes discovered by Ipatieff and his coworkers are basic contributions to America's superior aviation fuels.

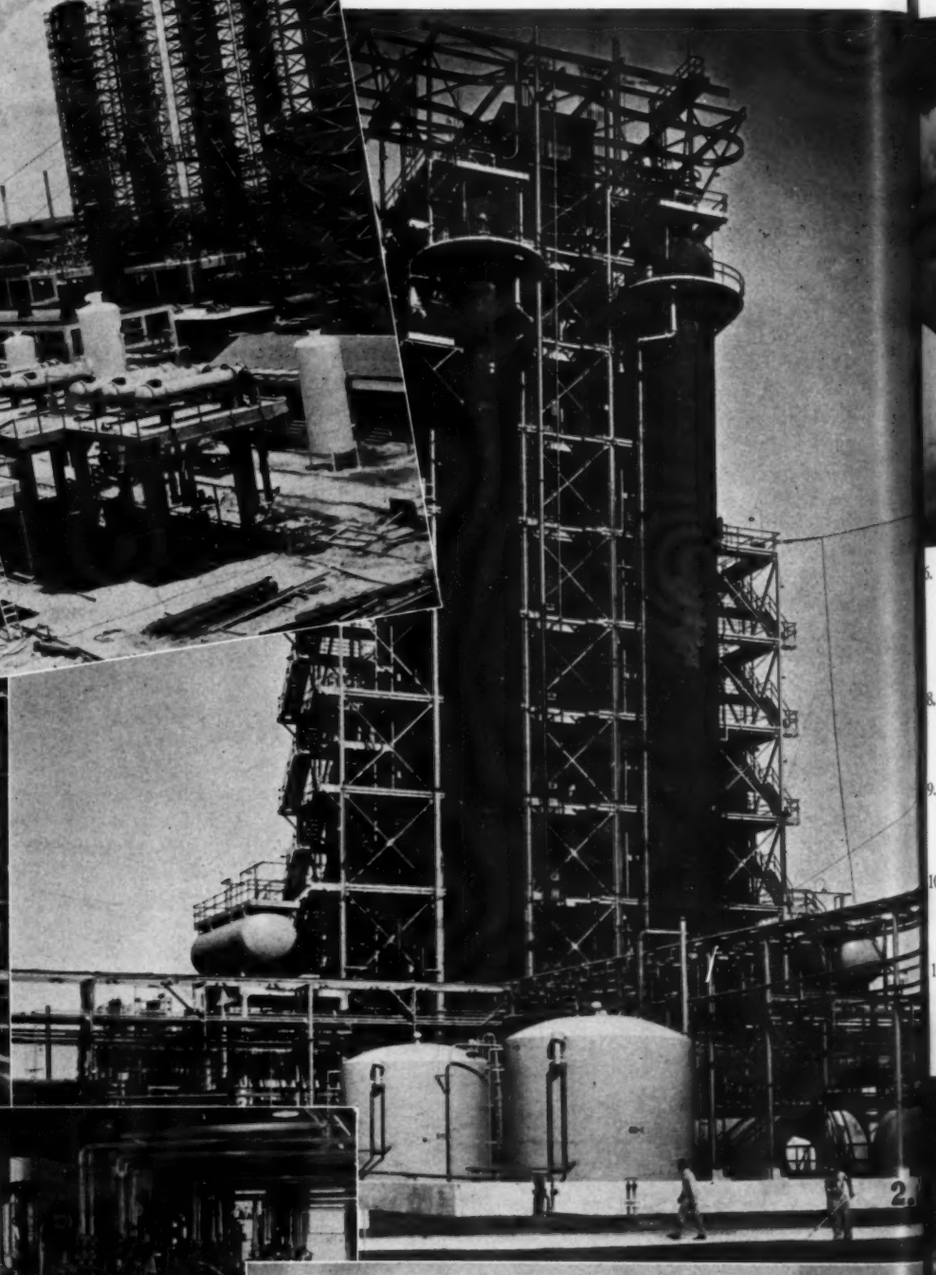
Prof. V. N. Ipatieff

TEXAS BECOMES NATION'S LEADING RU

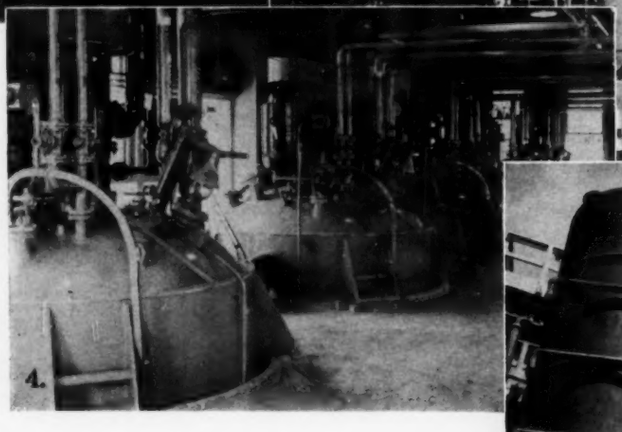
ALTHOUGH Texas leads all other states in many lines of industry rubber, heretofore, has not been included among its products. Beginning with 1944, however, Texas can add to its other "firsts" the rank of being the foremost supplier of the nation's essential rubber requirements. It will contribute to every phase of the synthetic rubber program with the country's largest plants devoted to the production of butadiene and styrene, princi-

2. Much of the Styrene Required for Synthetic Rubber Is Being Produced at Monsanto's Texas Plant.

1. Tanks and Towers of Neches Butadiene Plant.

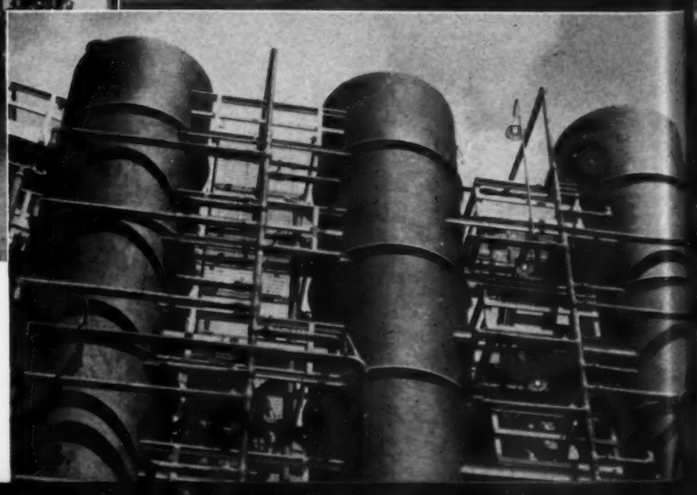


3. Hundreds of Valves Direct the Flow of Liquids at Neches Rubber Plant.



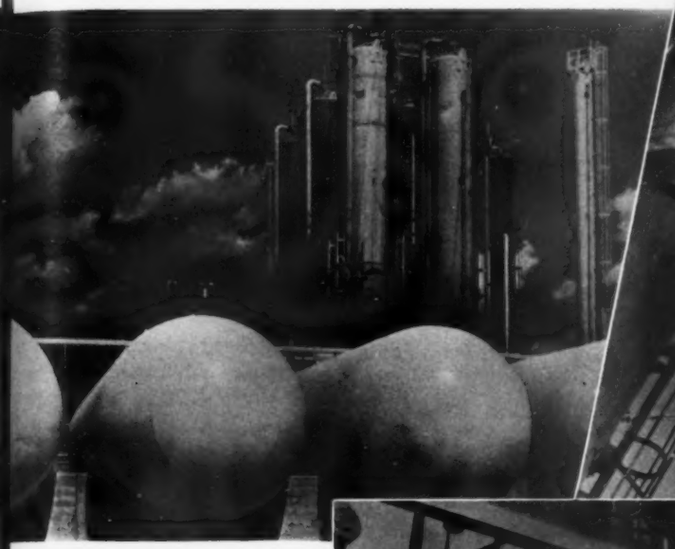
4. Polymerization Tanks at "Rubber Rancho" of B. F. Goodrich Co.

5. Giant Stripping Columns at 120,000-Ton Goodrich Copolymer Plant, Neches.



RUBBER PRODUCER

pal raw materials for GR-S rubber, and with other great establishments—copolymer units—in which these raw materials are fabricated into finished products. Over 40 percent of the raw materials of synthetic rubber will be produced in the Lone Star state and 30 percent of the rubber itself will be fabricated there. Incidentally, Texas will also supply the carbon black so essential to rubber manufacture.



6. Butane Storage at Phillips Butadiene Plant.

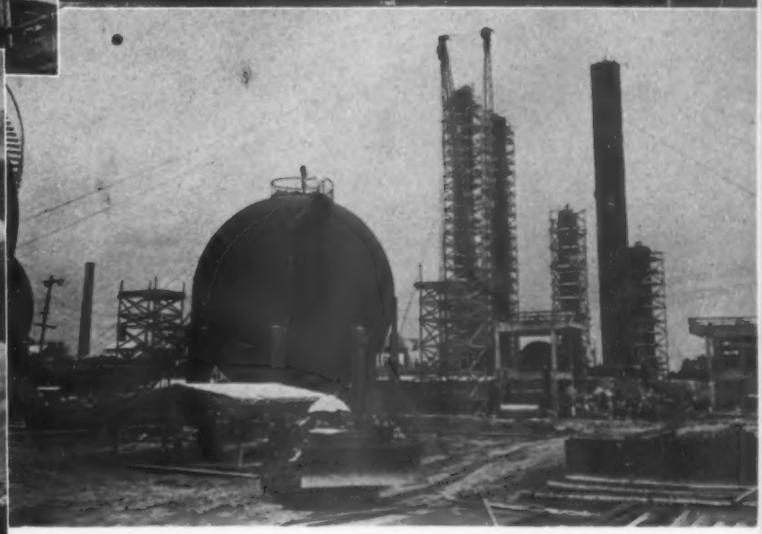
7. Towers of Fifteen Story Height are Characteristic of Texas Butadiene Plants.

8. One of the "Dutch Ovens" at Phillips Company's Plains Plant.

9. Lofty Towers of Plains Butadiene Plant of Phillips Co.

10. Feed Stock Storage Tanks at Sinclair Plant.

11. Fractionating Towers Under Construction for Sinclair Rubber Co.



INTERNATIONAL ASPECTS OF PETROLEUM

Downward Trend of Discovery in United States with Rising Requirements Points Need of a Balanced World Program for Production and Distribution—Importance of Soundly Based National Foreign Oil Policy

By Joseph E. Pogue

Vice-President, Chase National Bank

THE war has brought about important changes in the petroleum situation and through its stimulating effect upon demand, on the one hand, and its retarding effect on field developments, on the other, has created an entirely new relationship between prospective supply and demand. The record of the petroleum war economy is being written in two chapters, the first of which is nearly completed. The events of chapter one were primarily concerned with the far-reaching transportation dislocations created by the submarine campaign. During the first eighteen months of the war the major problems involved the establishment of transportation detours to meet essential requirements with minimum utilization of tankers, and the elimination of all dispensable consumption to ease the load. The shrinkage in tanker availability had to be countered by the development of extraordinary methods of transport overland and the taking of ocean-borne supplies from the nearest sources.

The second chapter in our current oil economy is introduced by a radical improvement in transportation capacity, as a result of the completion of extensive pipeline facilities and the favorable crossing of the curves of tanker construction and tanker sinkings. The breaking of transportation bottlenecks simultaneously on land and sea has fundamentally altered the economic and administrative problems of the oil industry and brings to the fore the elements of supply heretofore hidden behind transport barriers. But the problems of supply were not only masked during the events of chapter one, they were actually latent so long as demand had not risen to the zone of productive capacities. Now, however, the convergence of the trends of supply and demand is creating a new set of problems just as our transportation limitations are eased.

Petroleum production in the United States has enjoyed a rising trend since the inception of the industry, but the basis of production—the discovery rate—has fluctuated in conformance with price, the trade cycle, the emergence of new techniques, and other factors. For several years the trend of discoveries has been downward (although

some reversal is apparently in evidence in 1943), but whether the decline in the discovery rate is a cyclical manifestation or whether a subnormal level of discoveries will continue as a permanent condition is indeterminate, although the latter is perhaps the prevailing view. At the same time the demand for domestic crude oil, augmented by enormous military requirements, has been expanding sharply and against this trend our domestic oil fields cannot long meet the full requirements without strain.

When the producibility of the domestic oil reserve is examined in terms of rising requirements, it is found that a limitation is rapidly being approached. The Economics Committee of the Petroleum Industry War Council, in its July report, gave the results of a detailed study in these terms: ". . . for 1944 and 1945 the oil fields of the United States should not be counted on to produce *without waste* (italics mine) more than 4,200,000 to 4,300,000 barrels of crude oil per day . . ." Domestic production, which understates demand because crude oil stocks are being drawn upon, crossed 4,200,000 barrels per day in August, so that the estimated zone of maximum efficient production for American oil fields has already been invaded.

Production experience over the past fifteen years has thoroughly established the principle that if production in any field is allowed to exceed a certain level called the optimum, or maximum efficient rate, there is both a loss in ultimate recovery and a subsequent decline in producibility, perhaps on the average to the extent of 25 per cent. Production in excess of the maximum efficient rate for the country at large should be avoided if possible and resorted to only in case of sheer necessity. In the face of a demand such as now in prospect, there are only four ways in which wasteful production can be avoided. First, civilian consumption might be restricted in further degree, but aside from more effective enforcement of gasoline rationing there is little slack to take up on this score without encountering the danger of impairing the domestic economy. Second, higher prices or tax abatement measures could stimulate discovery and producibility, but there has been long delay in invoking these developments. Third, military and lend-lease demands might be reappraised in the light of the new conditions and adjustments may be possible in this field. Fourth, the allocation of demand to available sources of supply could be placed on a world basis and a more efficient flow-pattern developed and induced by the development of facilities appropriate to this end. Gain can doubtless be made in all four categories, but an effective safeguard against wasteful production and unnecessary depletion of the domestic resource requires a world basis for supply.

Fortunately the importance of a balanced world program for the production, refining, and shipment of oil is fully appreciated in many quarters and the techniques are available for its implementation. What is needed is a more balanced allocation of world demand to all available sources of supply. It is believed that a fully integrated effort along the lines indicated above can obviate the undue impairment of the domestic oil resource. It is to the interest of both the war effort and the domestic economy that this be done, and the improving tanker situation makes this possible.

It is well known that the reserves and producibility of oil in the Middle East and in the Caribbean region are much greater than now utilized. Reserves in the two areas combined are larger than in the United States, while producibility from existing wells is several hundred thousand barrels per day in excess of recent takings. True, the limitation in both areas is refining capacity and to some degree pipeline transportation, rather

Presented before National Petroleum Association, Sept. 21, 1943.

than producibility, but these bottlenecks can be broken by further installations, on the one hand, and a freer international movement of the oil, on the other. And producibility can be radically augmented by additional drilling.

Whatever the administrative disposition of the problem may be, the economics of the petroleum situation indicate that the oil resources of the Middle East and of the Caribbean region will be drawn upon more fully for war purposes, and future increments to the military demand will be diverted more and more to these sources. In fact, this shift is already well under way. It is clear, therefore, that for the duration of the war the American petroleum industry has become indissolubly linked with foreign sources of supply and no major domestic oil problem can now be resolved except in the light of all foreign alternatives.

At the very core of all production thinking is the rate of production and particularly the best rate, all factors considered—that rate which has been termed the optimum, or maximum efficient rate. This is the most fertile concept, or discovery, that has emerged from our production experience and it is almost axiomatic that it is unsound to produce any oil field in excess of its optimum rate. It is also important to understand that a field may be soundly produced below its optimum, if economic conditions require. The application of the optimum rate, therefore, is not symmetrical in an administrative or economic sense. The economic cost of exceeding the optimum is much greater than that of falling short of it—the first having social implications, the second merely delayed monetary realization. We may therefore set forth the following principle which is thoroughly grounded in established practice and in conservation policies as followed by the state regulatory bodies and the Interstate Oil Compact Commission; namely, the oil fields of the United States should not normally be produced in excess of their aggregate optimum rate nor should they be operated below their optimum rate except to avoid overproduction.

At any given time the optimum rate of crude oil production in the United States must exceed, equal or be less than demand. In the first case, the pressure of supply will tend to create an excess of exports over imports; in the second case, the balance of trade in oil will approach zero while in the third case, foreign oil will be required to fill the margin and this nation will become a net importer of petroleum. The domestic optimum rate, accordingly, will be the ultimate determinant of the position of this country in respect to imports and exports of oil. But whatever these relationships may turn out to be, the organizing and technical ability of the American petrolem industry should have a great role to play in the development of oil resources the world over.

The industrial advancement of the world in the postwar period depends more upon transportation than upon any other single factor. No other instrumentality has had a more profound influence upon the world order. Transportation is a stimulant of production and in its presence natural resources and technology combine to create useful commodities. But transportation is not a static concept; it is itself undergoing change. The type of transportation that accompanied and supported industrial developments in the past will have altered and become automotive transportation in the era of reconstruction and expansion that will characterize the postwar period. This change in the form of transportation has been so long under way and its future implications are so obvious as to require no further elaboration. Petroleum is essential to support the development of the transportation facilities necessary to create rising standards of living based upon expanding production and trade. In this light, petroleum and the industrial structure through which this resource functions take on a pivotal character of the first importance. It is scarcely too strong an assertion that the future of the postwar world is dependent upon the disposition made of petroleum as an economic and social force.

The petroleum industry has developed techniques and operating patterns which will prove invaluable in postwar expansion throughout the world. In addition, it has demonstrated a peculiar genius, derived no doubt from the pioneering aspects of the industry, which is difficult to describe and to make clear to anyone who has not lived with this subtle element. It is this genius that has been instrumental in discovering nearly all of the oil found in the entire world outside of Russia, and its techniques have even been contributory to developments there. It is this genius that has in the past ten years developed in the United States, against almost impossible legalistic odds, a system of efficient production reconciling competition with the advantages of cooperation in oil pools of divided ownership, adapting for this purpose a workable form of collaboration between the individual operators and the oil-producing states—thus revolutionizing engineering practices, equities, and political-economy in our oil fields. And it is this genius that has facilitated the development during the war period of a system of dual planning and management whereby government and industry are collaborating in the task of directing the complex pattern of petroleum operations to war objectives. These experiences, together with its command of technology, not only fit this industry for participation in the execution of postwar international oil policies but make it essential that its understanding be drawn upon in the formative period of thinking and planning toward those ends.

The problem of postwar world reconstruction cannot proceed along sound economic lines without the establishment of petroleum in a role consistent with its importance. For this purpose it is necessary that the United States formulate a foreign oil policy that will at the same time serve the interests of our country and further the productive capacity and volume of trade of foreign countries. Such a policy should be friendly to American enterprise, which has demonstrated its ability in oil developments the world over, and should have the objective of making foreign oil activities commercially attractive so as to create a dynamic urge toward further progress. To these ends our nationals will need freedom from burdensome operating controls, stability of contracts, and parity with all competitors. If these conditions are provided by international understanding, this country and its petroleum industry can make an outstanding contribution to the future stability and well-being of the entire world.

Puerto de la Cruz, outlet for one of Venezuela's newer fields.

Lone Star recycling plant.

OIL PRICES AND OIL RESERVES

Problem of Maintaining Different Price Levels for Different Classes of Production Can Be Solved Only by Government Acceptance of Complete Industry Centralization to Replace Historic Competitive System.

By Dr. O. W. Willcox

In the discussion over methods to be adopted to conserve and recover the known deposits of oil existing within the United States and to enlarge reserves to the extent necessary to maintain the high rates of withdrawal now in effect and in prospect a sharp division of opinion has developed between the Office of Price Administration on the one hand and the Petroleum Administrator for War and the petroleum industry on the other. The latter advocate a lifting of the present low ceiling price fixed for crude oil as the one sure and effective means of maintaining marginal wells in operation and providing an incentive for discovery of new fields. The OPA has steadily refused to permit a general price advance on the ground that it might enable some oil producers, now operating at a profit, to add to their earnings, though the government, under existing laws, would recapture the bulk of this additional income in taxes. It proposes instead a federal subsidy on wildcat drilling which practical oilmen and economists regard as futile and certain to lead to grave abuses.

The accompanying article outlines the first workable plan proposed for establishing varying prices for various classes of producers. World Petroleum publishes this plan without prejudice or endorsement. As will be seen, it involves a complete reversal of the legal policy heretofore followed by the government in forbidding price agreements among members of an industry and a complete abandonment of the competitive conditions heretofore enforced, but it does illustrate the type of control and the degree of regulation required if cost equalization is to be established.

FROM whatever side the subject of oil reserves in the United States is currently approached, the main fact which sticks out is that the geologists and the wildcatters, whose business it is to find oil deposits, are now running a losing race with the oil well operators whose business it is to extract oil from the ground. There was once a time when the situation was the reverse. Oil was being discovered in quantities exceeding the rate of withdrawal, so that every year there was an addition to the quantity of oil known to be in reserve. Year by year the known reserves accumulated, until not long ago they amounted to about 20 billion barrels, more or less. But at the same time the rate of consumption was increas-

Skidding to new location after drilling dry hole.

ing, and about 1937-38 the rate of withdrawal began to overtake the rate of discovery; the situation then began to change from a process of accumulation to a process of depletion.

Although the reserves are apparently still large enough to last for a decade and a half the prospect that they may eventually run out is disagreeable to contemplate. How to put discovery rate back on a par with consumption rate is a problem that is evoking much serious discussion. First among the principal suggestions that have been put forward is that measures be taken to intensify the search for new oil by placing more exploring crews in the fields and drilling more wildcat wells. To this suggestion the answer is made that since 1933 there has been a gradual increase in the number of new fields discovered culminating in 1941 with a peak of 275 discoveries, the greatest number of new fields ever opened in this country in a single year. But the pools of oil in these new fields have been small ones, and all together not sufficient to halt the decline in reserves. The average smallness of these pools means that the average rewards of wildcatting are small for the financial risk involved. This risk has been steadily increased by rising costs of the labor and the materials required for exploratory work and for the drilling of wildcat wells.

The oil industry has never shown a disposition to shy at financial risk so long as the price of oil was remunerative. Up to the end of 1941 the industry was finding the price remunerative enough to carry on exploration and wildcatting on an unprecedented scale.

Then came war—and the OPA, which placed a ceiling on crude oil prices. But the rise in the cost of finding oil kept on and reached a point where expense amounted to an average of about 30 percent of the total cost of producing the oil. Under these circumstances exploration for oil began to slacken even in the face of appeals from PAW for an expansion of production and the drilling of 4,500 or more wildcats in 1943. To this appeal it was answered that all the petroleum geologists in the country put together did not know where to find 4,500 likely structures or prospects; that many more prospecting parties would have to be put to work to explore new territories and that in view of the reduced margin between cost and price many wildcatters were becoming discouraged.

The shrinking margin between cost and price has brought into prominence two other matters affecting both the current production of crude oil and the broad problem of reserves.

There is a lot of oil known to be in the ground that is not generally included in the calculated reserves and is waiting to be produced—at a price. This is the residue of oil that remains in an oil sand after the original reserve has ceased to flow under its own power into the bottoms of the wells and thus come within reach of the operator's pump. When this hapens the field is said to be depleted so far as the primary means of production are concerned; unless measures for secondary recovery are put into effect this residual oil, which in many cases is equal to if not greater than the portion recovered by primary means will be forever lost. Secondary measures of recovery include repressuring the wells either by water drive or gas drive. To be most successful a repressuring project must include all the wells of the field, and involves a large capital expense for drilling put-in wells for power, and for other oil engineering necessities. The cost of secondary recovery is usually greater than the cost of primary recovery, so again the question of price enters to deter the production of oil that must otherwise be written off the nation's reserves.

While secondary recovery, which would have the effect both of adding to the available reserves and of increasing current production is being repressed by the ceiling price, the same ceiling price is acting to force the closing down of many oil wells that are still being produced by primary means. This refers to what are known as "stripper wells", which are wells that have ceased to flow naturally to the surface so that the oil has to be pumped. A pumping well becomes a stripper well when its daily production has fallen to about 10 barrels a day. According to a report by a Com-

mittee of the Interstate Oil Compact Commission nearly three fourths of the nation's oil wells are in the stripper class, and occupy more than half of all the oil acreage. These strippers in 1942 produced 200 million barrels of oil, nearly a sixth of the total production. It is estimated that the primary reserves of the strippers amount to about 1,250,000,000 barrels and their secondary reserves are about 2,500,000,000 barrels. Between the ceiling price on the one hand and the higher costs of operation on the other hand, the stripper operators are being severely pinched. A stripper well is abandoned when it costs too much to operate it, and as cost and price come closer together the number of abandoned wells increases. The number of abandonments in 1942 was 10,434; these abandoned wells were producing more than 56 million barrels of oil a year. The sad thing about these abandoned wells is not only that their current production is lost at a time when some 4,500,000 bbl. of crude need to be run to still per day, but also that the condition of abandoned oil fields deteriorates so that secondary recovery becomes impossible.

In the words of the authority quoted above "The nature of a stripper well is such that operating expenses per barrel are greater, and if these valuable reserves are to be saved (or else forever lost) the crude oil price structure must be revised upward at once."

All these circumstances add up to the conclusion that if our primary reserves of crude oil are to be replenished, if the marginal wells whose production is so necessary at this time are to be kept in operation, and if the reserves in depleted fields where secondary recovery is practicable are to be made available the price ceiling now maintained by the OPA over crude oil prices must be removed or at least lifted high enough to infuse the oil industry with enough energy to meet the problem which it and the nation now face.

In standing pat on its ceiling and looking over its shoulder at the specter of inflation the OPA says that a general advance in the price of crude oil is not warranted, because (quoting the Tariff Commission) the price of oil and the margin above costs are now greater than in most recent years. Among other criticisms leveled at the findings of the Tariff Commission are that it gives no consideration whatever to return on invested capital (which is the one thing needed to induce wildcatters to assume risks); that it gives no consideration to the cost of finding oil; and that the smaller operators whose costs are highest but whose production is still vital are ignored.

However, the OPA has shown uneasiness over the declining rate of discovery of new oil and the advancing rate of depletion, and has tentatively advanced a proposition to give a subsidy to wildcatters who undertake ventures in unproven territory. This alternative of a subsidy is held by the OPA to be preferable to a general price increase because of a fear that many oil producers would pocket the extra margin of price and make no effort to put more geologists, geophysicists and wildcat rigs in the field. Why swell the already good-enough profits of owners of flush fields who will not stir themselves in the search for new oil?

But the industry and a large section of public opinion are cool to the subsidy proposition. The industry is against it because it would mean bureaucratic dictation of the choice of locations to be drilled, which would become bones of contention between individual groups and occasions for log-rolling on the part of political interests.

The final position of the matter is that all hands are agreed on the need for redoubled effort to find oil, and on the need for making sure that oil once found shall be fully produced. From the industry standpoint a subsidy is undesirable. From the standpoint of the OPA a general, nondiscriminative price increase is against the public interest. If both the subsidy and a general price increase are rejected, what other way can be found that will allow the wildcatters, the repressurers, and the strippers to recover their costs by giving them a higher price for the oil that they have won in the face of extra difficulties? To do that, it will be necessary to establish two sets of prices for the same grades of crude oil: a fair price for oil derived from existing fields where production is abundant and inexpensive, and higher prices for new or hard-won oil. The problem then will be to create a market structure for the oil industry that will exclude bureaucracy on the one hand, and on the other hand keep any part of the reward intended for new or handicapped but necessary enterprises out of the pockets of those who have not earned it.

There is one possible way of achieving this result though whether it will be acceptable either to the price fixing authorities or to the men best equipped to find the needed oil may be open to question. A complete working model of just such a market structure already exists, and for years has been in operation in most of the world's sugar industries and in some others such as coffee. This system has previously been described by the present writer in several other places. Now that both the petroleum industry and the government of the United States are seemingly at a loss for a mutually acceptable method for stimulating the search for new oil and for assuring the complete exploitation of all known reserves, it appears pertinent to outline the system once more.

To begin with, the two main principles under which the national sugar industries of many nations are cooperating with their governments for the benefit of both the producers and the publics are already well known to the petroleum industry of this country. These principles are: proration of production and controlled prices for both the raw material and the finished product. Thus no radically new ideas are involved; but what is lacking in the petroleum industry are the details of proration and price control which the sugar men and their governments have put into practice.

In brief, the system is as follows: The government passes a law authorizing the producers to organize themselves on a nation wide basis as a self-governing industry, with a Board of Directors elected by vote of all registered producers. The Board is permitted to constitute two committees. One of these committees is to supervise the distribution of production quotas according to a formula acceptable to a preponderant majority of the producers. (This is the familiar idea of proration, which assigns to each producer his "allowable"). The other committee is to act as trustee for the sale of all the allowed product of all the producers. The price at which all grades of product are sold are fixed every year by a Price Board which is composed of representatives of the raw material men, the processors, labor, and consumers. The prices thus agreed on, subject to final approval of the government, become the legal prices (and as will be seen immediately, these prices become not only legal but also actual —they are made to hold against all would-be evaders). The enabling law gives the producers wide latitude as to the matters included in the constitution or charter of their self governing industry, except that it must not impose hardship on any particular interest and not be otherwise contrary to the public interest, of which the responsible cabinet minister will be the judge. When accepted by a vote of 75 percent of all members of the industry representing at least 75 percent of the production, and approved by the government, the constitution of the industry becomes binding on all the producers.

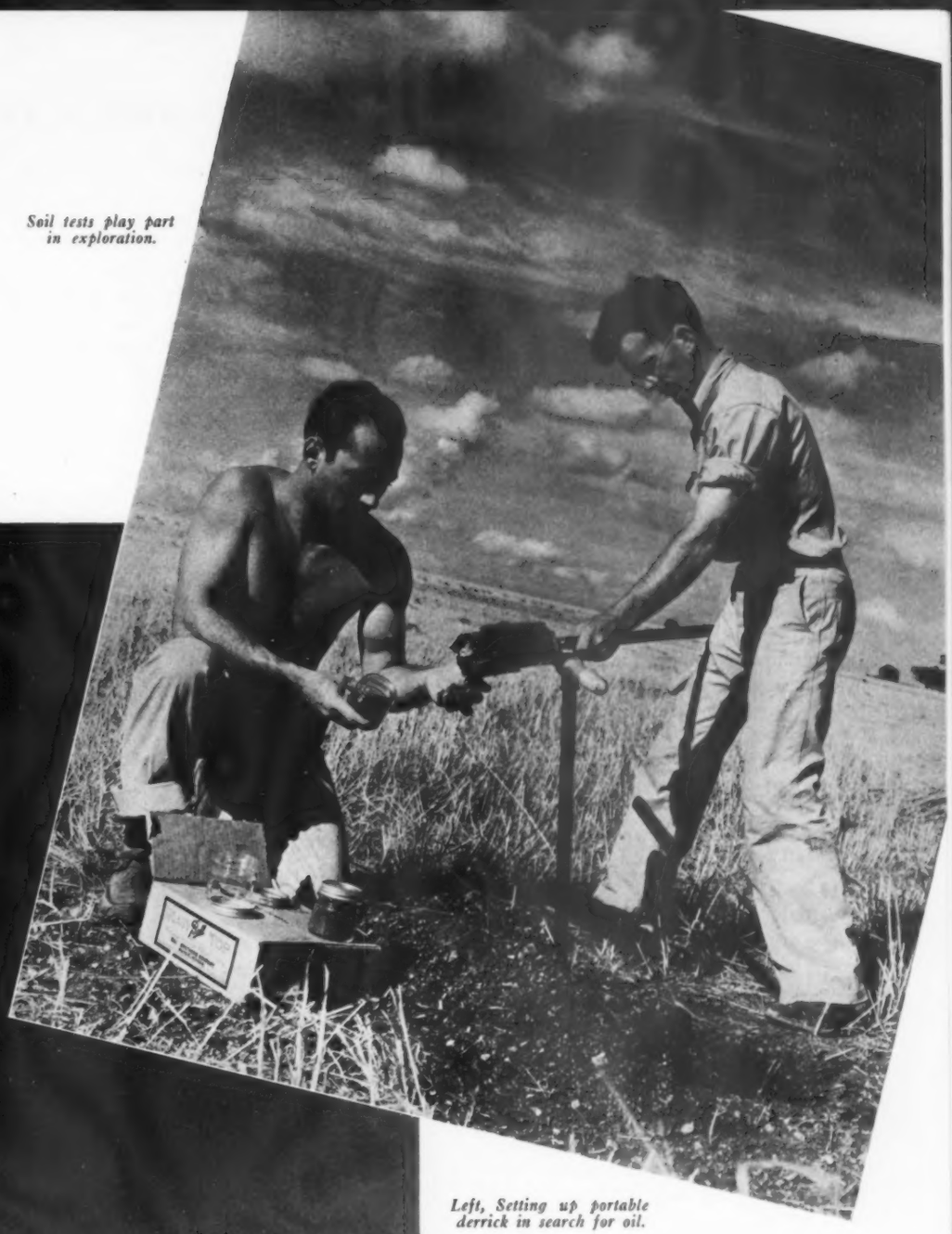
Readers interested in further details of this remarkable system as it was operating (before World War II.) in more than 20 sugar producing countries may refer to a series of articles entitled "What Shall be Done About Proration?" in WORLD PETROLEUM, 1941, Nos. 5, 8, and 11.

The present article is confined to pointing out how such a system would handle the price question which now stymies the oil industry and the government, and contains a real threat to the nation's supply of oil.

Some sixty years ago an Ohio Senator coined the classic phrase "The way to resume is to resume," which has become a standard expression for carrying a project to its complete finish and logical end; no tentative, half-hearted business, or jobs half finished, which means not finished at all. The philosophy under which sugar is produced and sold on most of the world's domestic sugar markets is that if prices are to be controlled, the control should be complete and absolute without possibility of evasion by individuals or groups, and this is the way it has been done in a score of sugar-producing nations (not including the United States):

The committee which acts as trustee for the sale

of all the "allowables" of all the producers is, in effect, a Central Sales Agency for the whole industry. More than that, the Agency is invested with de jure and de facto ownership of the product as soon as it is ready for delivery by the producer, who is paid the price that has been fixed in the manner prescribed by the industry's constitution or charter that was framed by representatives of the industry in collaboration with the government. The Agency then transports the product to market and sells it to the dealers at a price that is also fixed in a prescribed manner; the dealers in turn are required to sell it to the public at a price that is invariable from the first day of the year to the last.



Soil tests play part in exploration.

Left, Setting up portable derrick in search for oil.

The core of this system is the Agency's complete and undivided possession and control over the entire supply. The producers can sell their raw material to no one but the Agency, and the distributors can obtain supplies only from the Agency. Being thus in legal and actual possession of the entire supply the Agency has no trouble at all in collecting the legal fixed price from the consumers. Thus the problem of how to fix prices and make them stick is solved.

The enabling legislation that allows the national sugar industries of many countries to govern themselves often contains a provision that permits the charter to assign different rights and obligations to different categories of producers.

The intent of this provision is to enable the Agency to pay a higher price to producers who are under special difficulties. It is this provision that has direct bearing on the situation affecting the expansion and conservation of this country's oil reserves.

As in the petroleum industry, the sugar industries of most countries are composed of big and little enterprises. On the one extreme are giant corporations with immense factories and great plantations that can produce at very low cost, and at the other extreme are numerous small enterprises of low capitalization and small out-

(*Continued on page* 43)

ECHOES FROM THE WASHINGTON OIL FRONT

By **W. P. Maddox,** Chief of Washington Bureau

HAVING "bulled through" the rubber program, Big Boss Bill Jeffers slipped quietly out of Washington and left the job of keeping the production of synthetic rubber on schedule in the lap of his successor, Col. Bradley Dewey. In handing in his resignation, Mr. Jeffers reported to the President that "the big job covered by the recommendations of the Baruch report is done". Col. Dewey picked up the ball without missing a stride. He is something of a "buller-through" himself, and during the battles over components and rationing he has been in there slugging it out alongside his chief. In addition he is an experienced technical man, knows his chemistry and engineering.

Col. Bradley Dewey

Mysterious PRC

As was to be expected the new Petroleum Reserves Corporation bobbed up at the September meeting of PIWC. Members of the Council wanted to know something about the activities planned for the infant corporation. There has been much conjecture about it because so little actually has been revealed. Petroleum Administrator Ickes, its president, took refuge under the cloak of "military secrecy", and declined to enlighten members on the subject. He hoped he would be able to say more at the Council's next meeting, and reminded members that this was the first time he had held back information from them. In refusing to divulge PRC plans, Mr. Ickes is observing the ban he put on his staff against talking. Only the merest crumbs of information have been doled out, and the tight-lipped secrecy has only served to fire speculation as to the purpose of the corporation and the full scope of its operations.

PRC has wide powers. It can acquire foreign oil concessions, build refineries, pipelines and other facilities to supply the Army and Navy abroad. The concessions can be leased to American oil companies for operation, but so long as the government has a financial interest it naturally will have something to say about management. This poses some interesting post-war possibilities for the extension of American influence in international petroleum affairs. And it is not unlikely that the Administration had just these possibilities in mind in bringing PRC into existence.

Bob Allen Takes A New Job

ROBERT E. ALLEN has resigned his post as Assistant Deputy Petroleum Administrator, to become director of the newly created department of information of American Petroleum Institute, officed in New York City. API thus again is to have a public relations program, under another name. The executive committee recently budgeted "not over $50,000" for the undertaking during 1944. Mr. Allen was one of the first men summoned to Washington to join the staff of the then Petroleum Coordinator when that predecessor of PAW was established and has played a leading part in its development and operations. He knows oil literally from the ground up, having started as a tool dresser and roustabout in the West Virginia oil and gas fiields. He has served in many responsible positions since then and knows the problems and the personnel of the oil industry as few men do.

Robert E. Allen

Suppressed Controversy Causing Agency Pains

THE White House ban on inter-agency squabbles is causing both OPA and PAW to suffer severe pains from suppressed diatribes over the Ickes recommendation for an increase in the price of crude oil. Sizzling letters are credibly reported to have passed between the heads of PAW and OPA but neither one can let them out. "There is no question that the President's order was a wise one", Oil Price Advisor Sumner Pike of OPA confided to WORLD PETROLEUM, "but it just happened to catch us with only one side of the story told, and that not OPA's".

At the same time there are bitter charges from the opposite camp that OPA pulled a hidden ball trick in the press release by its Labor Policy Committee labeling the price increase proposal "a big steal".

Wallace Explains Again

VICE-PRESIDENT WALLACE is developing a reputation as the "explainingest" public speaker in the capital. His recent denunciation of big corporations as a public menace raised such a clamor that he amended it by declaring that only five or maybe three percent were really bad actors. For his second assault he picked Standard Oil Company of New Jersey which has heretofore been considered a perfectly safe object of political attacks. Standard President, Ralph W. Gallagher, came back with a lightning punch in which he declared that his company was inalterably against cartels and pointed out that its work in bringing buna rubber to the United States and in rubber research had provided the very foundation of the synthetic rubber program. This called forth another statement from the Vice-President in which he admitted some of Standard's claims but asserted that it had retarded the establishment of synthetic rubber plants in the pre-war period—a time when synthetic production was commercially impracticable.

Vice-President Wallace

More Trucks But Not Enough

THE War Production Board has given its approval to an initial truck and trailer program for 1944 which authorizes the construction of 22,859 medium trucks, 10,993 heavy trucks and 14,067 trailers. Included in the list are 400 tank trucks and trailers for the movement of petroleum products. PAW's estimate of minimum truck requirements for all industry operations in 1944, which WPB so far has declined to approve, calls for 1,200 light, 5,150 medium and 4,095 heavy trucks.

Hull Didn't Go Behind The Woodshed

SECRETARY of State Hull's public spanking of Argentina is of particular interest to oil men because drilling equipment is one of the main things the Argentinians have been seeking to obtain from this country. Foreign Minister Storni, in his note, had reminded Mr. Hull that Argentina offered to increase shipments of fuels and heavy oils to American countries if the U. S. would furnish machinery to increase production. Unfortunately, thus far, he said, the request had not been heeded. The rugged Tennessean brought the rod down deliberately, saying: "With regard to the petroleum negotiations, it may be pointed out that Argentina, thanks to its natural resources, the production of which has increased during the war period, and to its ability to import, has enjoyed during the past year and a half far greater oil supplies for the consumption of its civilian population than have the neighboring

Cordell Hull

republics. Those republics have received extremely limited supplies made possible through cooperative action in which the government of the United States and of the producing republics other than Argentina have participated. Considerable hardship and sacrifice has resulted owing to the serious shortage of oceangoing tankers. Thus, while the Argentine people were enjoying their normal civilian requirements, the peoples of Uruguay, Brazil, Paraguay, Chile and, in general, other republics were receiving only approximately 40 percent of normal civilian requirements. Argentine assistance would have been of great value during this very difficult period.

"The negotiations to which your letter refers have been concerned with the provision of materials and supplies to enable the future production of the Argentine oil fields to be maintained and even to be increased. The lack of these materials has not in any way affected the ability of Argentina to cooperate with the neighboring republics during the past eighteen months if Argentina had desired to cooperate".

This would seem to slam the door on any prospect of obtaining early clearance for the large amount of oil industry equipment Argentina has on order with U. S. firms—at least until tangible evidence of cooperation for hemisphere solidarity is forthcoming.

Senators Study Canol Project

WITH the reconvening of Congress most of the wandering statesmen who have been studying the conduct of the war and of war production in distant places have returned to the Capital. One party that is still out is a sub-committee of the Truman Committee consisting of Senators Kilgore of West Virginia, Wallgren of Washington and Ferguson of Michigan, accompanied by Rudolph Halley, counsel for the full committee. They went to Alaska to "inspect military and naval installations" and it was understood that their tour would include a visit to Fort Norman, Canada, to look over the Army's big Canadian oil project, the cost of which has caused some lifting of eyebrows on Capitol Hill. Whether their return will result in raising the veil of secrecy that has been spread over this undertaking remains to be seen.

Senator Moore Collecting Ammunition

SENATOR ED MOORE of Oklahoma has added to his staff a research counsel, the same being Guy H. Woodward, who was chief counsel at Tulsa for the Stanolind companies. It is understood that Mr. Woodward will gather ammunition for the Senator who, as a "Jeffersonian democrat" elected on a Republican ticket, is an arch enemy of bureaucrats. He was associated with the Senator when the latter was president of the Independent Oil and Gas Company. Senator Moore has provided his associates and his constituents with numerous surprises since his advent in Washington and the Woodward appointment suggests that he is planning to take the warpath again in furtherance of his pet crusade.

Senator Moore

OIL PRICES AND OIL RESERVES

(*Continued from page* 41)

put at relatively high cost. Like all the other producers, the big enterprise can sell only its allowable, and cannot use its efficiency to destroy competitors. The little enterprise also has its allowable which it may have difficulty in producing under a flat non-discriminative fixed price, and here is where the provision that different members of the industry may have different rights gets in its work. The charter provides that the existing enterprises may be classified on an engineering basis into a number of categories (the classification is effected by engineers on the Agency's pay roll), and the Price Board requires the Agency to pay the producers according to a scale which gives the most efficient enterprises the lowest (but still a profitable) price, while the most handicapped enterprises are paid the highest price.

The efficient enterprises have no reason to complain because they get a fair price on their allowable production and the publics where this system is operating do not complain over this device for keeping marginal projects alive. The system has been justified on social-economic grounds which cannot be reviewed here.

Now let it be supposed that the petroleum industry has obtained a similar charter from the government of the United States. Under this charter the industry itself takes charge of prorating petroleum production on a fully nationwide basis and sets up a Central Sales Agency to acquire and to distribute all the product of all the producers.

The Price Board obtains a government approval of retail prices that will be uniform throughout the country. Finally, let it be supposed that there has been inserted in the charter a mandate to the governing board of the petroleum industry to keep oil consumers well supplied and to use all practicable means of expanding and conserving the nation's oil reserves. The board has all the means and authority for executing the mandate. As stated above, the oil industry has never shied from wildcatting risks when the price of crude oil was good, and the board would need only to announce that it is prepared to pay a good price for new oil; no subsidy or handing out government money with strings tied to it; no dictation as to locations to be drilled. The wildcatters would use their own money and their own judgment as to where they would drill, just as they have always done under the stimulus of the profit motive. On the other side the board, assisted by its own engineers and in consultation with the Bureau of Mines, would fix prices for secondary oil that will assure the final exploitation of fields that have ceased to yield to primary means, and a price for stripper oil that would keep marginal wells in production as long as the public interest required.

Doubts will perhaps arise over the practicability of installing this system in the United States, because it calls, first, for agreement among the petroleum producers on an organization for putting it into effect, and secondly, it calls for approval by the law making authority. To get the oil men to agree among themselves, and then get the government to agree with the oil men that the industry can itself run the oil business in the interest of the public may seem to be a hopeless task. The fact that sugar and coffee producers in more than a dozen important sugar-producing countries in both the new and the old worlds have accepted such a plan, and the fact that the governments of these countries have approved it and enacted it into law, seem to indicate that it is workable once the principle on which it is based is accepted.

Right now, the industry is subject to a regime in which the main features are controlled production and distribution proration, and a fixed price. It may be supposed that the status quo will be restored after the war, but no one can be too sure about that. The matter of future reserves of petroleum has reached a critical pass which only a sound price policy, fair to all interests and to the public, will be able to surmount. Government control is quite visibly in the offing, and if it is to remain in effect, it would seem that the industry has a stake in giving this control a form under which execution of an approved working plan would be intrusted to the coordinated efforts of the industry itself, with a minimum of bureaucratic intervention.

RAPID WORK RESTORED WRECKED WAR INSTALLATION

BACK in early August mention was made in news reports that shipments of petroleum products from the Gulf Coast area had been reduced temporarily as the result of a hurricane, but no details of the storm's effect were given out. Now that the damage has been repaired, permission has been given to reveal one of the dramatic incidents involved which strikingly exemplifies American resourcefulness in dealing with any emergency that may arise.

The storm occurred on July 27 and was of great intensity though of brief duration, with wind rising to a velocity of 132 miles an hour. Among other widespread damage it blew down a giant water cooling tower fifty feet high and weighing 1,409,215 pounds at the Deer Park refinery of Shell Oil Company, twenty-one miles from Houston. The tower was completely wrecked and left as a tangled mass of piping and wood work as shown by an accompanying illustration. Operation of all generators in the refinery ceased instantly with the collapse. Production stopped, a serious matter, since the plant's output of high octane gasoline and toluene is employed for aviation use and in the manufacture of TNT.

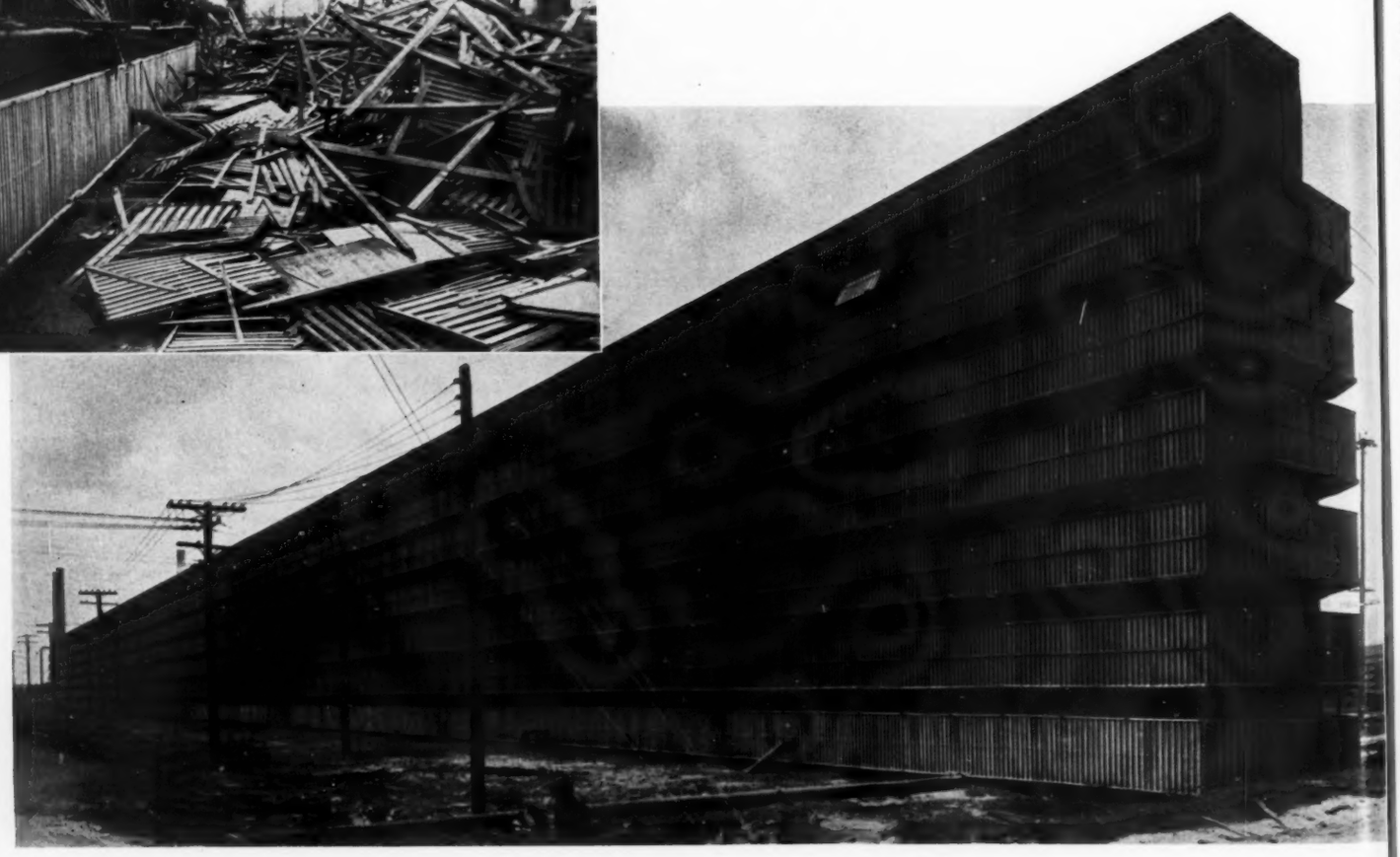
The cooling tower had been built by Fluor Corporation, Ltd., of Los Angeles. With all wires down the refinery was isolated and it was not possible even to communicate with Fluor's local office in Houston. While the plant stood idle and Shell employees tackled the job of clearing away the debris, Lyle Kendall, chief engineer of the refinery, started out to make the trip to Houston by car. His path was repeatedly blocked by live wires, overturned vehicles, blown-down buildings and water overflowing the road, but he succeeded in negotiating the normal 45-minute trip in a matter of five hours.

On Mr. Kendall's arrival at the Fluor office things began to hum. The plant in Los Angeles went on a 24-hour day schedule immediately upon receipt of the message from Houston. The ODT in Washington was enlisted in the fight to resume production and the Southern Pacific railroad operating between Los Angeles and Houston exerted all energies to help speed reparations. As parts were finished in Los Angeles they were loaded in various types of express and baggage cars. These cars were hooked to fast passenger trains and the shipments were handled as express rather than freight. The Port Terminal railroad at Houston rushed the shipments to the plant as fast as they arrived from the West. The hurricane happened on the final Tuesday of July. Shipments started leaving Los Angeles the following Friday night and arrived at the refinery early on the next Monday morning, when the work of reconstruction began immediately. Shell employees volunteered to work beyond their regular hours. Some of them slept on the refinery premises. The Fluor Company assembled a crew of skilled workmen from the Texas area to supervise the job. Other suppliers to the oil industry offered both materials and personnel. P. E. Foster, manager of the refinery, kept things moving at top speed. Within a few days it was possible to resume partial production and the rate of output increased until three weeks later when regular schedules were once more being kept. Ordinarily the construction of such a cooling tower would have taken fifty to sixty days.

Continued on page 46

Left: Debris of wreckage of huge water-cooling tower.

Below: New Shell water-cooling tower upon completion.



Foreign Oil Legion

R. M. Cook

SECURITY Engineering Co., Inc. of Whittier, California, has announced the recent appointment of R. M. Cook as Sales Manager of that company. Mr. Cook is well known in the oil industry and brings to the firm an extensive background of oil field experience, having spent his entire career in the oil business. He was associated with Byron Jackson for 11 years as sales manager and was active in conjunction with that firm in organizing the Pacific Cementing Company, now known as International Cementers Inc., in which he carried out the duties of vice president and general manager. He later became associated with McCullough Tool Co. in the capacity of sales manager. For the past 15 years Mr. Cook has been active in midcontinent areas and is well acquainted with the various drilling and producing problems in these areas.

FOUR executive changes are announced in the head offices of the Shell Oil Company, Inc., in New York to meet readjustments necessitated by the recent creation of a department of industrial relations. The new department will function in close conjunction with the personnel department under the combined general management of E. H. Walker, heretofore personnel manager. George H. Dempster, formerly assistant personnel manager, becomes manager of the personnel department. John C. Quilty, previously special assistant to Mr. Walker, has been appointed manager of industrial relations. L. A. Lohman, named assistant manager of the newly created department, was industrial relations assistant in the New York personnel office. All four men have been in the employ of the Shell company fore more than 10 years.

ALBERT S. GUSTIN, SR. of the Gustin-Bacon Manufacturing Co. died August 28 at his home in Kansas City. Mr. Gustin was one of the first industrialists to convert to war production. Ninety-five percent of the output of his plants now is war goods and the plants fly the Army-Navy "E" flag.

DR. GORDON N. SCOTT, expert consultant in corrosion mitigation, has joined the executive staff of Industrial Engineering Co. in the capacity of Consulting Engineer in charge of Research and Development. Dr. Scott brings to his new duties an experience in the highly specialized field of corrosion investigation that is perhaps the most extensive in the industry. His knowledge of Somastic pipe coating dates back to the early days of this product's development and commercial utilization.

KENNETH E. COOK, of the public relations department of the Standard Oil Company (N. J.), has been granted a leave of absence to join the public relations department of the Petroleum Administrator for War in Washington, D. C. Mr. Cook will be engaged on a special assignment which is expected to be completed within three months, upon which he will return to Jersey Standard.

Mr. Fred Murray, new President Oil Well Supply Company

H. G. SCHAD, general manager of transportation of The Atlantic Refining Company, has been elected a member of the board of directors of the company, it was announced today. He will fill the vacancy on the board caused by the recent retirement of William Downs Anderson. Mr. Schad joined the company as assistant to the general manager of transportation in 1925, and was made general manager in October, 1941. He is vice president and director of the Keystone Pipe Line Company and the Buffalo Pipe Line Corporation, and a director of the Atlantic Pipe Line Company, all subsidiaries of The Atlantic Refining Company. He is also a director of War Emergency Tankers, Inc.

WALTER H. COX, who for the past four years has been sales representative for Lee C. Moore & Co., Inc. with headquarters at Evansville, Indiana, has been transferred to the company's home office in Pittsburgh, Pa. where he will have charge of

E. H. Walker

Dr. Gordon N. Scott

H. G. Schad

oil field sales in the states of Pennsylvania, New York, West Virginia, Ohio and Michigan.

Walter H. Cox

POSTWAR conditions and naval action in the Pacific were the topics discussed at the September meeting of Los Angeles Nomads. Walter E. Elieson of the United States Department of Foreign and Domestic Commerce spoke on "Markets After the War" bringing out many factors that will influence the conduct of postwar business.

A second speaker was Al Brick, who was head of Fox Movietone News in Honolulu at the time of the bombing of Pearl Harbor. He preceded his talk with motion pictures in sound of the bombing and told of his experience with the Navy in the battles of Midway, Bismarck and Coral Sea. He was stationed on several aircraft carriers and was in action in planes from the carriers. At times, in addition to his photographic work, he served as gunner and radio man. Before getting back to this country he spent some time on Guadalcanal during the American invasion.

Among the foreign guests at the meeting were Excellency Jorge Zelledon, Secretary of the Interior of Costa Rica, and Hon. Carlos Grimm, Vice Consul of Mexico.

F. L. WALLACE, General Superintendent at Port Arthur since May, 1939, has been named Works Manager. Replacing Mr. Wallace as General Manager is D. P. Bailey, who returns to Texaco from a period of service with the Petroleum Administration for War.

F. P. DODGE, for the past four years Works Manager of the Texas Company's Port Arthur refinery, has been appointed Assistant to the General Manager of the Refining Department. He has been assigned to special duties, and will remain in Port Arthur.

APPOINTMENT of Douglas L. Hooker as member of the Manufacturing Committee of Socony-Vacuum Oil Co. Inc. has been announced by Wilbur Burt, Director in charge of Manufacturing. Mr. Hooker was serving as manager of the Paulsboro, N. J. refinery of Socony-Vacuum, when he was moved up to replace John Stanley McElfresh who died in August. Among his responsibilities will be supervision of Eastern refining operations and, at the war's conclusion, foreign refining operations.

H. W. Sheldon has succeeded Mr. Hooker as manager of the Paulsboro refinery. A. A. Neff has been advanced to the post of superintendent and W. T. Furey has stepped up as assistant superintendent.

THE first conference of the Institute of Petroleum of South America on liquid fuels will be held in Buenos Aires on October 5-12 and its purposes are: To study the way to itensify the production of liquid fuels in the South American countries; To consider the decisions which might be adopted to promote the rational utilization of liquid fuels in South America; To examine the possibilities of increasing the exchange of liquid fuels between the South American countries. The attendance of prominent members of the North American technical and industrial world is expected to assist in the solution of many problems of capital importance which affect the development of the oil industry and the oil trade in South America.

UNREPORTED in the South Pacific war zone since the fall of Manila, George S. Colley, Jr., Vice President of W. A. Bechtel Co. is alive and well on Borneo, although a Japanese prisoner. This news, transmitted August 21 through the International Red Cross headquarters at Geneva, will be happily received by his many friends in the petroleum industry following the long period of uncertainty.

Colley has been identified with the Bechtel organization's extensive pipe line construction activities, for many years as the executive in charge of this phase of the company's work. When war was declared he was engaged in building augmented naval and air facilities at Cavite on Manila Bay, directing construction for this company as project manager under oceanwide naval contracts being executed by Contractors Pacific Naval Air Bases. Both at Cavite and across the bay on the cliffs of Bataan the construction organization continued its work under constant attack until forced to capitulate by the proximity of Japanese occupational forces.

In early January 1942 Colley, together with his wife, Mr. and Mrs. Harry Webber and Ashton Laidlaw left Manila in a motor launch. They were traced as far as Balabac Strait northeast of Borneo, and before reaching this point the party had transferred to a small sail boat. From that time until August 21, 1943 no word was received of the whereabouts or fate of the party. Fortunately the news came in time to dispatch greetings and word from home by the Swedish exchange ship, the S. S. Gripsholm.

Douglas L. Hooker

(*Continued from page* 44)

Fifty-six cars were used in hauling the parts from Los Angeles to the Shell plant, at a cost ten times in excess of ordinary freight charges. Some idea of the tower's bulk can be gained from the fact that it has a cooling capacity equivalent to that required for the production of 24,000 tons of ice per day. It stands more than 50 feet in height and is more than 1000 feet in length, giving the appearance of a gigantic washboard. Wells in the vicinity of the refinery could not possibly supply the amount of water required in the emergency and water from the nearby rivers was too brackish for plant purposes.

In stressing the speed with which the reconstruction job was completed, Mr. Foster stated that the Friday-night-to-Monday-morning shipment by express was an operation that under normal freight conditions would have taken from 10 days to two weeks.

P. E. Hurley, superintendent of the plant, seconded Mr. Foster's tribute to the Fluor Company and to plant employees. He pointed out that typists, laboratory employees, operators and guards pitched into the job of salvage. A message to Shell employees at the end of the job said: "The management is grateful for the fine spirit of cooperation given by employees during and after the recent hurricane. Through your efforts in working long hours and your willingness in doing tasks which were foreign to your regular duties, the refinery was rapidly restored to as near normal as possible. It is this type of united effort which will always enable us to overcome obstacles."

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GASOGENES AND THEIR LIMITATIONS

ACUTE shortage of gasoline in European countries, particularly in those under Axis domination, has led to the extensive introduction of gasogenes —motor vehicles propelled by gas obtained by the burning of wood or charcoal. Outside of the European continent the only countries in which a considerable number of these machines are in use are Australia, Brazil and India. In the United States the very name is unfamiliar but suggestions have been made that gasogenes might be introduced to relieve the stringency in motor fuel for civilian use.

As a result of such suggestions, Dr. Gustav Egloff and Paul Truesdell of Universal Oil Products Company, have made a survey of gasogenes and of the conditions that would attend their adoption in the United States in place of the familiar type of motor car now in use. Statistically, they find that upward of 820,000 such vehicles were in use in 1942. Of these, two-thirds, or 541,000, were in operation in Nazi controlled countries. About 11 percent or 91,000 were in neutral countries and 189,000 or 23 percent were in lands included within the Allied group. Germany was well in the lead with 350,000 such cars while 110,000 were located in France. In neutral countries Sweden led with 73,000. Among members of the United Nations, more than half the total number were to be found in Russia.

According to Messrs. Egloff and Truesdell, four types of producer gas engines have been developed in Europe which may be described as up-draft, down-draft, cross-draft and double-draft or double-zone. The down-draft type is said to be most suitable for wood or charcoal. The report further states:

"The gasogene includes a generator with a fuel-hopper, coolers, filters (to dedust the producer-gas stream), gas throttle, and in some cases, a starting fan and water regulator. Most of the machine is made of sheet metal. Hoppers, coolers, and filters are usually galvanized or painted to lessen corrosion. Grates and tuyeres are made of alloys to resist heat and oxidation. The generator is lined with a refractory such as carborundum, magnesite, bauxite, or fire clay.

"On trucks the generator is commonly mounted near the front, either on one of the sides or just back of the cab. On busses and pleasure cars it is in the rear and may be carried on a small two-wheel trailer. Coolers are ordinarily placed beneath the vehicle. The filter is also placed there, provided it is horizontal. A final filter, if used, is located near the intake manifold. The wood is used in the form of small blocks or chunks.

"Here is the way the gasogene engine operates. First, the generator is charged with wood. When the engine is cold, it is customary to start operations with gasoline and to use it as an exhauster to draw the flame through the fuel bed from a torch inserted into the mouth of the tuyere. Ignition of the fuel takes place in about one minute, and the complete starting operations, from the time of inserting the torch to the time when the vehicle moves off on producer gas, takes from two to four minutes.

"Full power is not developed for some twenty minutes after starting, during which time it may be necessary to make occasional adjustments in the air control valve. When full power is developed, the performance becomes steady, and the controls require little, if any, more attention than on a gasoline-driven vehicle".

Portraying the situation that would exist in the United States if gasogenes were to replace its 32,000,000 gasoline-propelled vehicles the report says:

"Consider the picture here in the United States where we have more than 32,000,000 motor vehicles on the road. In 1941, a normal year, our gasoline production amounted to more than 28,000,000,000 gallons. On the basis of data presented, it would be necessary to cut down 3,000,000,000 trees a year in order to furnish enough gas to equal the 1941 production of gasoline. This would mean the destruction of 300,000,000,000 years of tree life and the denuding of more than 23,000,000 acres of woodland. Think of the armies of lumberjacks that would be required, the vast additional sawmill capacity, and the changes in transportation! Wood blocks cannot be pumped through pipelines or hauled in tank cars or shipped in tankers. And how long would it take to reduce this country to the treeless state of China?"

Gasogenes are more costly to operate than gasoline driven motors and are far less efficient. They are clumsy in appearance and awkward to manage. The wood or charcoal is burned in a stove which is built in a part of the car or carried on a trailer behind it. The equipment weighs from 300 to 1,000 pounds and the car must carry a bin to hold the fuel used in its operation. The conclusion reached is that gasogenes would not be voluntarily adopted in any country but would be employed only where an absolute dearth of petroleum prevailed.

GEOPHYSICS

Volume VIII, Number 3

JULY, 1943

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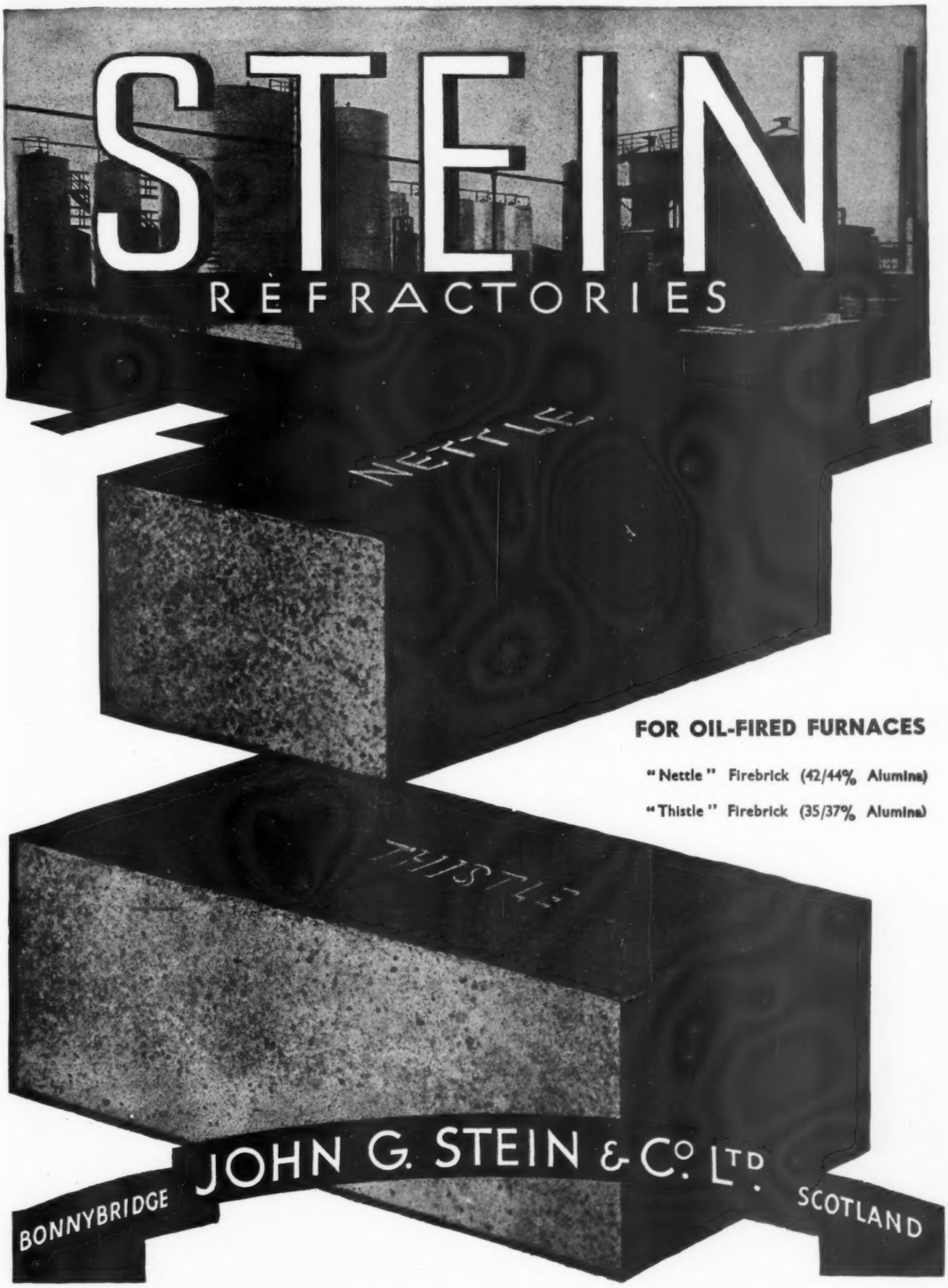

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BRITISH EQUIPMENT MAKERS ORGANIZE

BRITISH manufacturers of oil industry machinery and equipment are looking forward to a great expansion of construction activity which they regard as certain to follow the conclusion of the war and are preparing a joint effort to obtain a substantial share of the business involved in the restoration of destroyed facilities and the increased demand for petroleum products.

First steps toward the formation of the Council of British Manufacturers of Petroleum Equipment were taken early in the present year and the first annual meeting was held at the end of July. The organization, as explained by the Chairman in his address at the meeting, is intended to be of an educative, publicity and propaganda type operating on a broad, common policy and having nothing to do with trading, trade associations, price fixing and the like. Its members will exercise full freedom in promoting the use of their individual products but will act together in presenting the views of the industry to governmental authorities or departments and in directing attention to the scope of its established facilities and capacity for handling business. A more definite statement of its objectives are contained in the rules adopted which provide that it shall do whatever may be necessary to accomplish the following:

To foster and protect the interests of British manufacturers of petroleum equipment;

To bring the views of such manufacturers before international bodies, government departments, and trade, professional and other bodies and organizations;

To secure representation on committees and organizations where advantageous;

To prepare and formulate schemes and plans;

To carry out propaganda and publicity on behalf of the petroleum equipment industry;

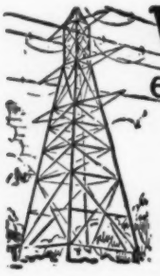
To collect and collate information for members;

To procure co-operation between members on all matters of common interest; and

To prepare and formulate plans and schemes for the development and expansion of the petroleum equipment industry in the United Kingdom and Northern Ireland.

The officers of the Council are S. T. Robson, Head, Wrightson and Co., Ltd., Chairman; H. Harper, Vice-Chairman; C. R. Sams, George Kent, Ltd., Treasurer; T. L. Bonstow, Secretary. The executive committee consists of these officers and the following members: Mark Burton, Marshal, Sons and Co., Ltd.; E. Bruce Ball, Glenfield and Kennedy, Ltd.; L. A. Callow, Stewarts and Lloyd's Ltd., and associated companies; J. O. Dick, Alley and MacLellan, Ltd.; R. Gourlay, A. F. Craig and Co., Ltd.; T. C. Hunt, Metropolitan Vickers Electrical Export Co., Ltd.; C. W. Knighton, Babcock and Wilcox, Ltd.; N. Matheson, Le Grand, Sutcliffe and Gell, Ltd.; Col. R. B. Pitt, C.B.E., Stothert and Pitt, Ltd.; Charles Rhodes, Joseph Rhodes and Sons, Ltd.; K. Symes, The Yorkshire Copper Works, Ltd.; J. Walsh, G. M. Marchant, Ltd.

The meeting concluded with an agreement that the executive committee should proceed to put into operation plans for collaboration between members for the advancement of their mutual interests, for the introduction of improvements that would make for greater efficiency and modernity in their operations and should make approaches to various authorities to see that their section of British industry should receive due consideration in postwar planning in regard to petroleum rehabilitation.



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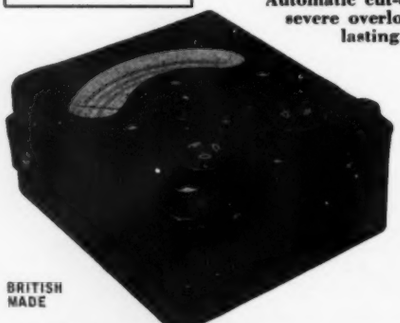

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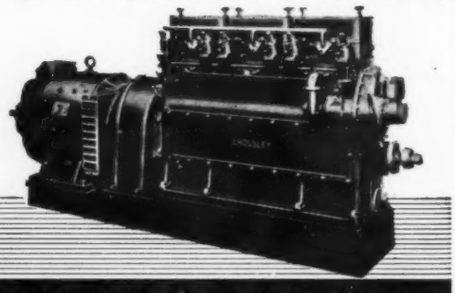

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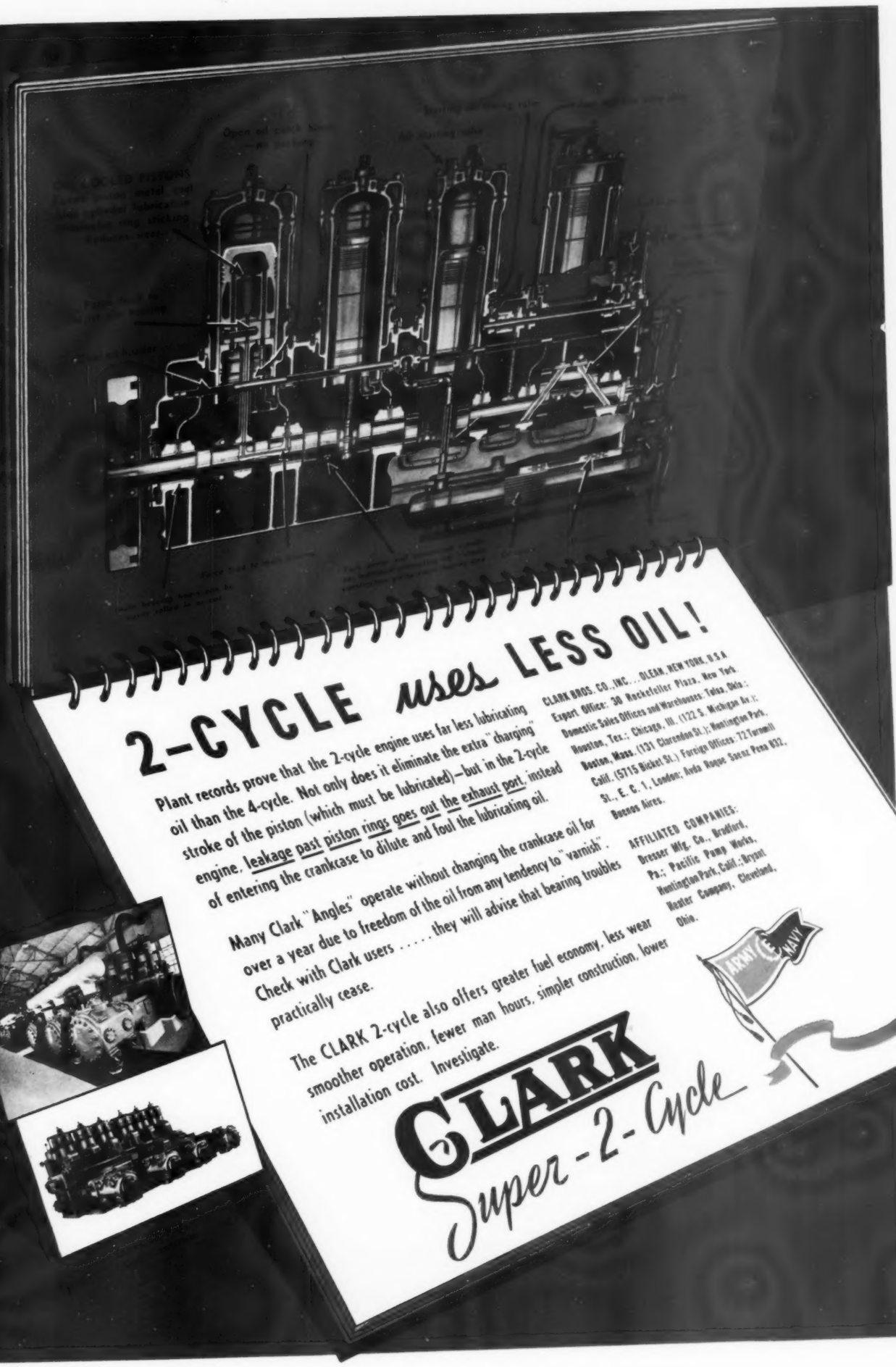
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Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry—Edited by Dr. O. W. Willcox.

GEOPHYSICS

Seismograph Evidence on the Depth of the Salt in Southern Mississippi—C. A. Swartz, in GEOPHYSICS, Vol. 8 (1943), No. 1, pp. 1, 2.

A number of shallow salt domes in Southern Mississippi have been surveyed by means of the seismograph. Reflection records, shot and recorded directly over the tops of several of these domes, exhibit persistent deep reflections that are believed to come from the base of the source bed of the salt. A distinctive feature of the records is the long time interval, following shortly after the shot moment, in which no evidence of reflections appears in the background of random noise. This portion of the records is assumed to represent the time required by the seismic wave to travel vertically down and back through the relatively uniform salt mass of the dome. Immediately following this reflection-free interval is seen a good reflected event which apparently comes from a deep interface which no doubt corresponds to the base on which the salt rests. By plotting the data from two domes the conclusion is reached that the base of one dome lies at a depth of 25,800 feet and the base of the other at 22,400 feet. These two domes are located in the south central part of Mississippi in the general neighborhood of the Choctaw Base Line.

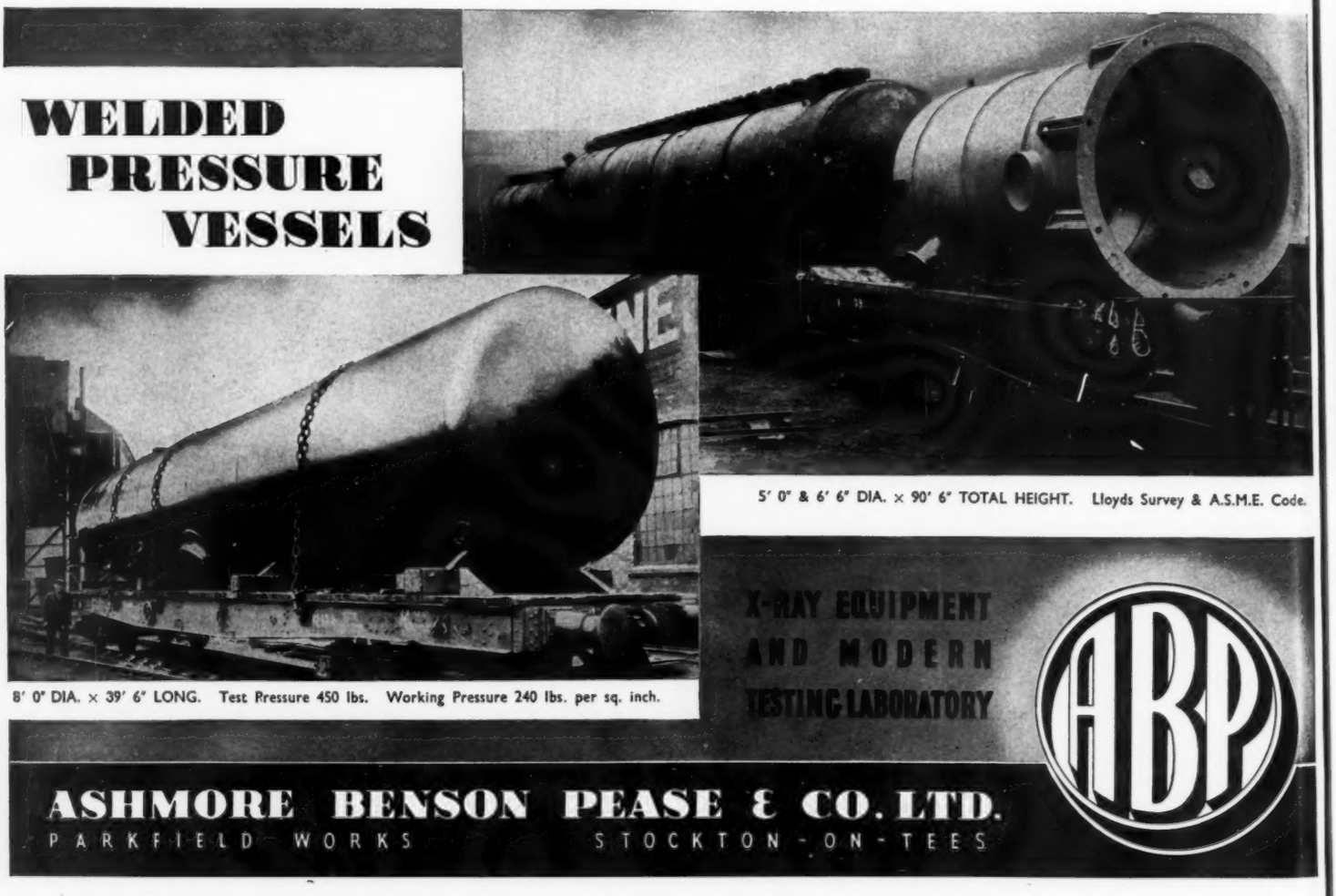
Natural Potentials in Well Logging—W. D. Mounce and W. M. Rust, Jr., before AMERICAN INSTITUE MINING METALLURGICAL ENGINEERS, PETROLEUM SECTION, Dallas, May, 1943.

Oversimplification has been the cause for erroneous interpretation of electrical logs but this fact does not reduce the value of the logs.

Normal interpretation is that "kicks" on the logs indicate sands. It not infrequently occurs that some kicks do not indicate sands and the situation becomes serious when it is discovered that a sand, an oil sand, was not indicated by a kick.

The usual theory is that sands are somehow correlated with the potentials. The theory is two-fold, the more popular phase being the "electrofiltration potential." If the natural-potential log were principally the result of electrofiltration, it would be a permeability log; or, if only the electrofiltration potential were affected by changes in pressure, it would be possible to determine the permeability by making two logs at different pressures and observing the differences in the natural-potential logs. Actually, the properties of the filter, which chiefly determines its effect on the electrofiltration potential, are its chemical nature and the condition of its surface. Its permeability has little or no effect. Any correlation between the natural-potential log and permeability is to be explained by the fact that some of the factors that affect the permeability of a sand also directly affect the potential.

While studying this problem one of the authors discovered a condition existing in wells under which current will flow in a chain of electrolytes. It gives a qualitative and semiquantitative explanation of some apparently abnormal logs. It explains how a zone of low potential may exist in the middle of a sand which by conventional interpretation would indicate a tight zone, where actual tests show that the permeability is about the same as in the remainder of the sand.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Investigations done on the problem, which included an ingenious testing device, suggest that when fresh water-drilling mud is used, the potential log may be largely a measure of the absence of argillaceous material in the formation. This conclusion is confirmed by the observation that large kicks are often found opposite beds of dense limestone and that most permeable beds which do not show kicks are found to contain substantial amounts of shaly materials.

OPERATION

Effect of Certain Microorganisms on the Injection of Water into Sand—F. B. Plummer and others, before AMERICAN INSTITUTE, MINING METALLURGICAL ENGINEERS, PETROLEUM SECTION, Dallas, May, 1943.

The author lists four types of organisms that are present in oil-field waters and appear to play a principal part in producing harmful precipitates. Among these are species of *Gallionella* that live in slightly acid water containing ferrous compounds. There are four types of sulfur bacteria which segregate sulfur in their cells, or produce hydrogen sulfide. Other bacteria reduce sulfates to hydrogen sulfide and sulfur which produce precipitates that are very effective in clogging sand pores. Algæ are present in warm oil-field waters in great quantities, kinds and varieties. The results of the study are summed up in the following conclusion:
Four types of organisms have been found in the waters from Luling and East Texas which change the chemical character of the water and cause precipitates of ferric hydroxide, sulfur, metallic sulfides and calcium carbonate, and produce gelatinous material, chitinous substances, and organic plant threads. These substances separately and collectively have strong clogging effects when water containing them is injected into oil sands as demonstrated by experiments. Results of work in the field and laboratory show that ferric hydroxide can be precipitated easily and filtered out by sand filters, and that the face of oil sands clogged with ferric hydroxide can be cleaned with hydrochloric acid. Experiments indicate that if the porous rock is limestone or calcareous sandstone, care needs to be taken to keep the ferric chloride from penetrating into the limestone.

Experiments also show that algæ can be killed easily with small amounts of copper sulfate, and the carbonate precipitates can be removed with hydrochloric acid. Gelatinous algal threads can be dissolved in concentrated sulfuric acid. The sulfur, metallic sulfides, and chitinous material which compose cell walls of some of the organisms are probably the worst clogging material and most difficult to remove. Sulfur bacteria and fungi can be killed by chlorine treatment or by filtering through a filter strongly impregnated with some disinfectant such as a mixture of dichloropropylene and dichloropropane, which has proved effective in destroying soil bacteria. It is doubtful, however, whether the chlorine placed in settling tanks will kill all bacteria or prevent their multiplication and growth in the injection wells and on the face of porous sands.

DRILLING

Acid Deepening of Wells—Leo Courter, in OIL & GAS JOURNAL, vol. 42 (1943), No. 6, pp. 58, 60.

It is frequently the case that the production characteristics of an oil well are improved by deepening it. In some fields it has been found necessary to deepen the well only a few feet in order to secure material increases in production. In these cases the cost of moving in tools to drill and clean out the wells is a large item in comparison with the amount of work to be done. Operators in some Oklahoma fields are overcoming some of these mechanical inconveniences and are keeping deepening and cleaning-out costs at a minimum by employing chemical methods.

The deepening of wells producing from limestone by the application of acid is not exactly a new idea. The author's contribution to the subject is to call attention to an adaptation of this practice in which the action of the acid is assisted by using a standard rock bit which is rotated by tubing or drill pipe, with results that are much more successful than the previous procedures. A standard pulling unit for raising and lowering the tubing during the drilling operation is in most cases the only equipment furnished by the well operator. The rotary table is mounted on a regular casing head or casing which is so constructed that the circulation or pressure encountered in drilling can be packed off. Power may be obtained from the motor of a truck.

The standard rock bit adapted to this work has a 7/64-inch jet in the regular water course which directs a stream of inhibited acid downward ahead of the bit. The high-velocity stream of acid dissolves and disintegrates the rock, leaving very little for the bit to remove. The pressure applied in the acid drilling operation depends on the existing circumstances. Using acid at the rate of 15 to 18 gallons per minute a non-porous limestone may be penetrated by a 4¾-inch hole at the rate of 8 to 10 feet per hour; in hard, cherty, limestones this rate may be appreciably reduced. The usual deepening operation in a limestone will require about 115 gallons of acid per foot of hole.

The main advantages of deepening wells by acid lies in its economy, costing about 25 percent less than the standard drilling methods. Other advantages are: minimum amount of equipment required by the operator; bailing of the well and mud conditioning are not prerequisites to the acid drilling method; shutdown is limited, not over two days being required for deepening a well; no cleanout is necessary after deepening; for the actual deepening the crew will consist of one tubing unit operator and a helper, but a regular tubing crew will be needed to make the two round trips at the start and at the finish of the operation; the acid serves the dual purpose of doing most of the drilling and increases the permeability of pay zones; as most of this type of work has been done in limestones, bailing to remove cuttings is not necessary.

The maximum of section drilled by this method in any one well is 62 feet and the results in this instance were entirely successful and profitable.

Selective Acidizing and Permeability Determination by an Electrical Method—Dana S. Hefley and P. E. Fitzgerald, before AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, New York, Meeting, February, 1943.

Heretofore there has been an important gap in the technique of acidizing oil wells. This refers to lack of means for determining accurately what part of the exposed section in the well should be treated, and the choice of procedure that would insure treatment of the desired section.

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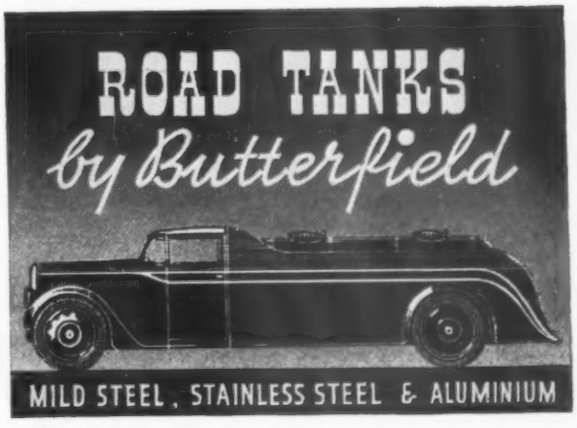


In the present state of the art the well acidizers have been relying partly on various modifications of the Carr method, by which an effort is made to confine the acid to the producing section by means of a column of oil; or a self-removing gel plug has been used to keep the acid out of an undesired section. A favorite instrument of the acidizers is the "jet gun", a tool which contains many small openings through which small streams of acid are impinged at high velocity upon the sections of low permeability.

All of these selective acidizing methods depended for their success upon the completeness and accuracy of well data provided by the geologist and engineer representing the well owner. Often it has been learned, too late in many instances, that the zones to be treated were inaccurately located or the data were so meager that no definite conclusions could be reached relative to the location of the permeable, porous zones which contained the oil.

Recently there has been placed in field service an apparatus known as the "electric pilot" which performs the double function of determining the relative permeability of various zones in a well bore, and of insuring that the treating chemicals would be introduced into the right zones. This instrument has the character of an "electrical fluid interface locator"; it consists essentially, of two electrodes (see figure) through which no current will flow except when a circuit is completed through a conducting fluid such as acid or salt water; if the electrodes are immersed in a non-conducting fluid such as oil no current passes.

The operation is as follows: The electrodes, attached to a steel tube several feet long, are hung on an insulated conductor wire and lowered into the well. The acid, and the oil which is to confine the acid to the selected zone, are run into the well in the customary manner. The function of the electric pilot is to show the operators at the surface whether the line of separation between acid and oil is at the chosen level. If no current is flowing, it means that the electrodes are in oil and the rate of injection of acid and oil are altered so as to bring the level of the acid up; if a strong current flow, it means that the electrodes are wholly immersed in acid, so the acid level must be lowered; if only a weak current flows, the electrodes are half in oil and half in acid, which is the desired condition. In this way the operator is assured that action is occurring at the right place.

Aside from this accurate control of the acidizing operation, the new technique affords an excellent method for making a permeability survey of an oil well before acidizing, and for determining relative porosities in planning secondary recovery projects. In this case the conducting fluid is salt water. Acid and salt water are injected at controlled rates into the well, and the rate at which a zone takes the salt water is a measure of the permeability of that zone. This is said to give a relative porosity log that is more discriminating than can be obtained from microscopic examination of well cuttings.

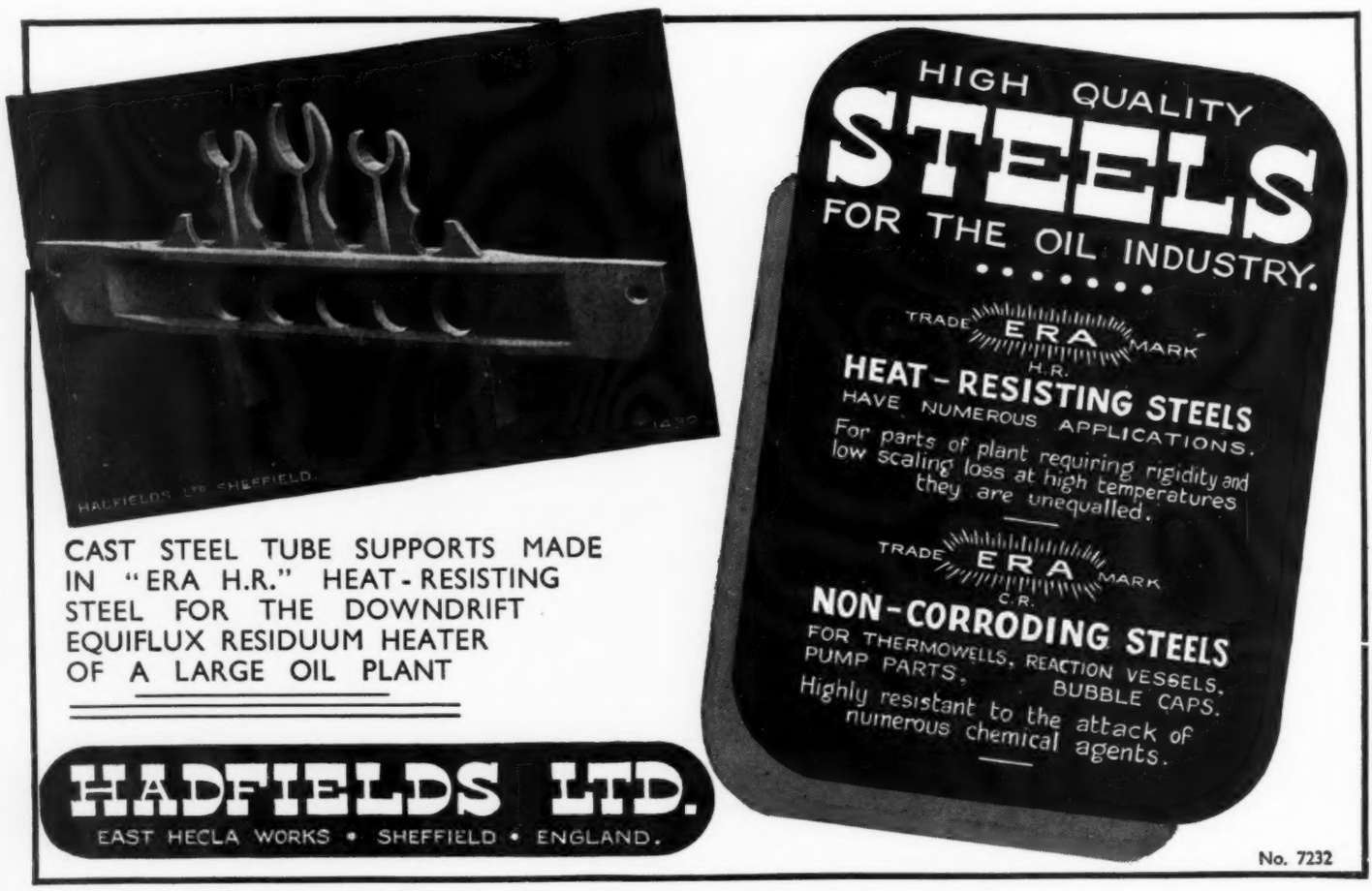
The "electric pilot" has been used in different types of wells in a number of states. The results to date indicate that new economies and efficiency in well treating, as well as new accuracy in permeability surveying, will be obtained.

ASPHALT AND TAR

Accelerated Weathering of Bituminous Materials—Effect of Operating Variables—Bruce Weetman (The Texas Company) before 46th Meeting, AMERICAN SOCIETY TESTING MATERIALS, June-July, 1943.

The service life of prepared roofing, as well as built-up roofs, depends to a large extent upon the weathering characteristics of the asphalt which goes into their construction. A satisfactory roofing asphalt must be able to withstand the deteriorating effects of the elements over an extended period of time. Since the roofing manufacturer guarantees his roofs for a period of several years it is essential that he know in advance the weathering characteristics of the asphalt that he is using as it is obvious that he cannot afford to wait a period of years for service data in order to control the quality of his manufacture. Neither can the asphalt producer wait for field data to determine the weathering characteristics of his asphalt, as by that time the original crude-oil stocks may no longer be available. The necessity of having a dependable accelerated test for measuring the weathering characteristics of asphalts is apparent.

This investigation of the effect of operating variables upon the accelerated weathering of asphalts has shown that the temperature of test must be accurately controlled if comparable results are to be obtained between laboratories. It is recommended that 140 F. black bulb panel temperature be used as the best temperature to obtain values which will adequately differentiate between the weathering characteristics of different asphalts in the shortest practical time.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Factors Influencing Declining Oil Discovery Rates —L. F. McCollum (Standard Oil Co., N. J.), before AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Fort Worth Meeting, April, 1943.

The decline in crude oil discoveries has been a subject of earnest discussion in the producing branch of the petroleum industry. The general falling off in the addition of new reserves from 1935 to 1942 is viewed as foreboding a hazard to this nation's supply of crude oil and its products, a hazard which is keenly sensed by the geologists on whom rests the responsibility of finding new reserves.

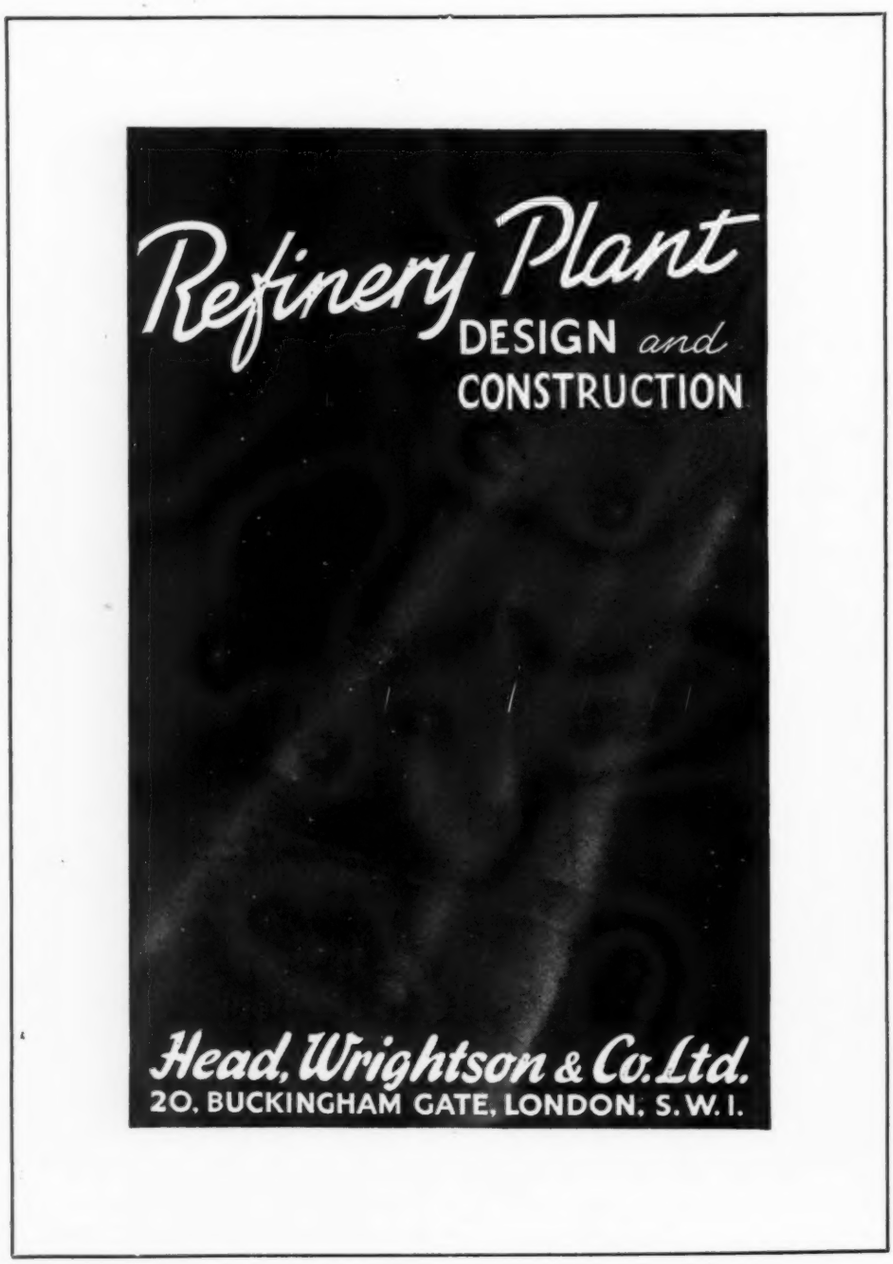
The fact is that the amount of crude oil required for war purposes and essential civilian needs during 1943 will be about 4 million barrels a day, with the prospect that in the latter part of the year there will be a peak requirement of 4.2 to 4.6 million barrels daily. To obtain this production the old, declining areas and some of the newer shut-in areas will be seriously strained. It is clear that exploration for new reserves should be accelerated, and, to repeat, it cannot be overlooked that while the number of new discoveries has been increasing the volume of oil discovered has been declining over the past several years.

There are several more or less evident reasons why the volume discoveries are declining. In the first place it is necessary to note that an increase in the number of new oil fields discovered does not necessarily mean an increase in the volume of new oil found. It is a fact that since 1933 the number of new discoveries has constantly increased, reaching a peak of 275 new finds in 1941, which is almost twice the number brought to light in 1933. But in spite of these new discoveries the total annual findings of new oil has declined. The average size of new discoveries in 1942 was about the lowest. This means that the new oil pools are smaller on the average, and may well cause doubt that our prospecting territory still holds large oil fields like that of East Texas.

The amount of oil found in new fields is not only declining but the rate of drilling new wells has fallen off nearly half since 1942. Some obvious reasons for this are federal spacing restrictions on oil wells (these restrictions being imposed because of the scarcity of materials), and the shortage of manpower which has reduced the average personnel of the petroleum industry about 15 percent.

The author pays particular attention to the influence of the price of crude oil on the rate of discovery of new oil fields. The data he has assembled fails to disclose any correlation between discoveries, the number of dry holes drilled (which is a measure of finding effort) and the price of crude oil during the past few years, and it does not appear that either manpower shortage or material shortage is decisive. It is therefore necessary to look for other factors that are influencing the quantitatively declining discovery rate.

The most decisive of these influences has already been indicated: the areas in which we have been finding new oil is running out of large oil pools, and is now yielding only small ones. To meet this situation several things must be done. The exploration branch of the petroleum industry must look for new territory and move into it. At the same time the oil geologists and the geophysicists must develop new and better implements and techniques for finding oil. It may be admitted that exploring for oil in new territories that do not look attractive, and research to improve present finding methods, will cost something, but these facts must be honestly faced and funds to carry on the needed search must be provided.



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A Method of Evaluating Service Performance of Slow-Curing Asphalts—Joseph Zapala, before 49TH ANNUAL MEETING OF AMERICAN SOCIETY TESTING MATERIALS, Pittsburgh, June, 1943.

An examination of the available literature on asphalts of the slow-curing type (known among highway workers as road oils) will disclose a variety of reports on construction technique, some reports on laboratory studies of basic characteristics, but no reports or data correlating performance in service with laboratory tests of the nature found in commonly used specifications.

To obtain information on this line a study of the characteristics and behavior of slow-curing asphalts was undertaken in Wisconsin.

Field and laboratory evidence indicate that a heat test of the type described in A.S.T.M. Method D 243 - 28 T can be used for the evaluation of performance in service of slow-curing asphalts.

The test can be used for control purposes by either specifying the time required to reduce the consistency of the asphalt from original to a consistency of either 100 or 150 penetration, or by specifying the consistency of the residue obtained after heating the asphalt for a given period of time.

The time of reduction or the heating period required to obtain a residue of given consistency can be determined for an asphalt or asphalts which have given satisfactory performance in service and this time, or times, may then be used as a specification requirement. A consideration of construction practices followed in using asphalts is of great value in establishing the requirement.

As a practical matter, observations of the service performance of mats throughout Wisconsin has revealed that some asphalts, from different sources, have consistently produced mats which have rendered service considered to be satisfactory by maintenance engineers. One of these asphalts was selected for the study of its residue obtained with the use of A.S.T.M. Method D 243 - 28 T. Portions of a sample of the asphalt were heated for different periods and graphs were plotted to show the relation between time of heating and percentage of loss and time of heating and changes in consistency. The data show that the consistency changed at a rate which would bring it to 100 penetration in 165 mm. The data indicate that at the end of 62 weeks residues may have consistencies much softer than that corresponding to 100 penetration; therefore, it does not appear to be essential to reduce to this penetration; reduction to 150 penetration consistency would be as convenient and for some asphalts this consistency might be closer to the consistency of the residue left in the mat after a period of service. The consistency of 100 penetration was selected as the end point in view of common specification requirements which express percentages of residues in terms of 100 penetration.

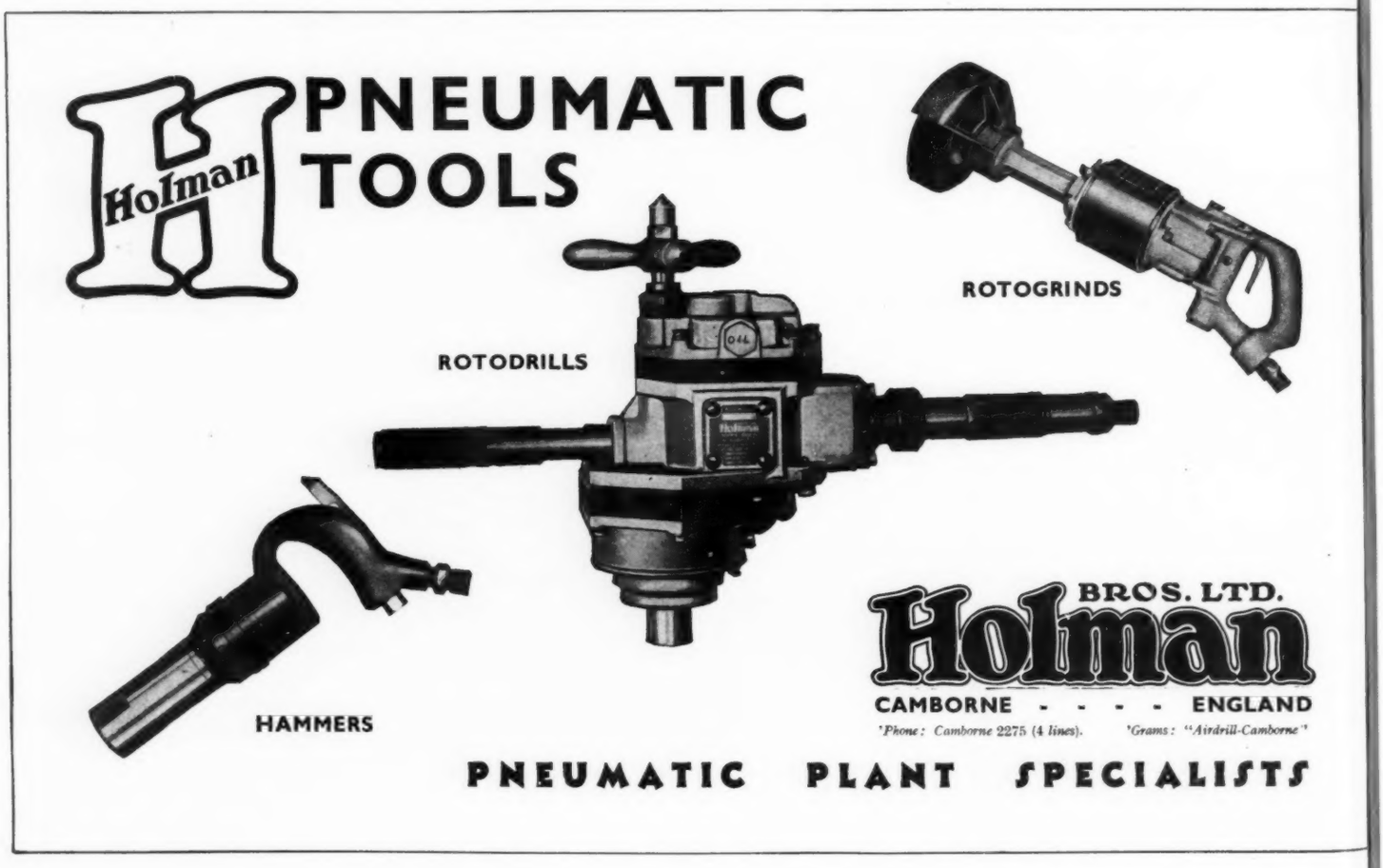
A Method for the Testing and Evaluation of Road Tars—E. O. Rhodes and H. E. Gillander, before 46th Meeting, AMERICAN SOCIETY TESTING MATERIALS, Pittsburgh, June-July, 1943.

Road tar specifications of the type most frequently used give satisfactory control over quality in the great majority of instances. However, the significance of some of the tests is open to question and it would be desirable to have tests that could be interpreted directly in terms of road performance. This problem has been attacked by a number of investigators.

The authors report on an accelerated weathering procedure that, when applied to a series of road tars, gave results that agreed with their observed performance in service. The test procedure makes it possible to bring about extensive alterations in some tars in one day's time. It gives (*a*) an estimate of the amount of evaporation that can be expected from the tar, (*b*) its probable rate of set up and ability to develop proper stability, and (*c*) its tendency towards embrittlement. This test procedure is a further development based on work done with an accelerated weathering procedure reported in 1936.

Data are presented indicating that in general, and particularly in the case of hot application grades of road tar, the softening point of the 300 C. distillation residue can be used to estimate the probable durability. Other data indicate that the present distillation limits on some grades of cold application road tars are too wide to control the quality adequately.

In outline, the new method is as follows: Air at 30 C. is passed through a tar-sand mix having tar films in the order of 0.006 mm. thick and extensive weathering is brought about in 23 hr. time. The test simulates the action that takes place on the surface of a densely graded or tightly sealed road but also will represent the action in the interior of an open-graded road. The test results, accordingly must be interpreted on the basis of knowledge of the road design.



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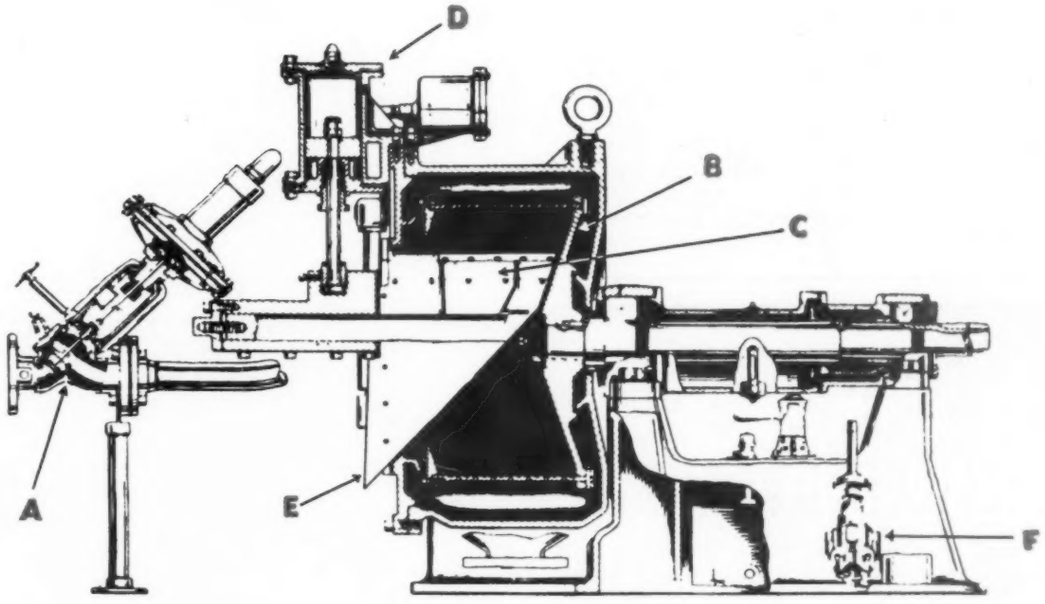

Slurry enters through the automatic valve A and feeds into the basket B which remains at full speed through the run. Another automatic valve controls the rinse spray. When the drying cycle is completed the knife C is raised by the hydraulic piston at D and diverts the cake down the chute E The pump F creates the hydraulic pressure. All operations are fully automatic.

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The test has been used to some extent in studying road tar specifications. The results indicate that, in general, and particularly in the case of the hot application grades, the softening point of the 300 C. distillation residue may be used to estimate the serviceability of the road tar when employed with proper types of construction. They also indicate that it is desirable to have closer distillation limits in the case of the cold application grade road tars.

The method in its present form is suitable for testing those materials which change primarily as the result of evaporation. The acceleration is obtained as the result of using extremely thin films which permit, practically speaking, the maximum amount of evaporation in a given time. The method cannot be used to evaluate materials which change through oxidative processes which may or may not be accelerated by light.

CHEMISTRY

The Effect of Water on the Stability of Gasoline Motor Fuels and Storage—Harry H. Power and Fraser H. Allen, before AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, PETROLEUM SECTION, Dallas, May, 1943.

Water is often intentionally introduced into gasoline storage tanks for various purposes, such as to float the oil from tank to tank, to raise or lower the oil level to the zero gage mark in certain tanks, to prevent oil leakage from tank bottoms by maintaining a minimum water level, or to detect leaks where light stocks might escape from tank bottoms by maintaining a minimum water level, or to detect leaks where light stocks might escape from tank bottoms unnoticed.

The deterioration of certain gasolines in storage is characterized by the formation of gum, haze, darkening in color, and loss of anti-knock values. Degradation is particularly emphasized in motor blends of thermally cracked gasolines containing conjugate diolefins. All of these forms of deterioration proceed simultaneously, although they are not necessarily related. Obviously, autoxidation requires access of the gasoline to oxygen or air, but may proceed very slowly in the absence of light. which is the usual storage condition. Deterioration is strongly photocatalyzed by ordinary daylight.

Tests on the deterioration of intensively dried gasolines, as compared with gasoline containing dissolved water, indicate that water is detrimental to storage stability. It was also found that the deterioration of gasoline which was in contact with a water phase containing dissolved air resulted in the extremely rapid formation of gum and peroxides in gasoline. These two observations lead to the following classification of gasoline storage conditions in the order of increasing severity.

(A) The storage of artificially dried gasoline under maintained conditions of absolute dryness.

(B) The storage of water-saturated gasoline over a water phase which contains no dissolved air.

(C) The storage of water-saturated gasoline in the absence of a water phase.

(D) The storage of water-saturated gasoline over a water phase which contains dissolved air.

The effect of air above the gasoline, or the presence of a natural or artificial inhibitor in the gasoline, will not affect the relative order of the four classifications of gasoline-storage conditions. The best practical condition of gasoline storage is in "contact" with an air-free water phase.

PHYSICS

Color Index, Light-Colored Petroleum Products—I. M. Diller, J. C. Dean, R. J. DeGray and J. W. Wilson, Jr (Socony-Vacuum Oil Co.), in INDUSTRIAL ENGINEERING CHEMISTRY, ANALYTICAL EDITION, vol. 15 (1943), No. 6, pp. 367-373.

The color of petroleum products is of importance in their processing and marketing. Hitherto, for its measurement, the petroleum industry has employed several systems, all of which are visual, and depend upon matching the color of the sample with that of a standard glass. Committee D-2 of the A. S. T. M. on Petroleum Products and Lubricants specifies two such methods, the Union colorimeter for lubricating oils and the Saybolt chronometer for light-colored products.

Both the Union colorimeter and the Saybolt chronometer are arbitrarily standardized and are not related to one another by any fundamental means. Furthermore, the specifications of each of these instruments are so drawn that sufficient latitude is allowed in the selection of color disks to permit an appreciable variation of results from instrument to

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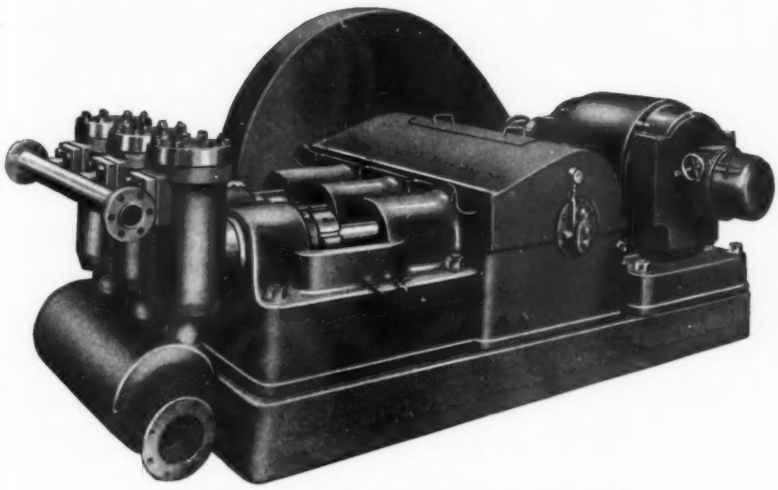

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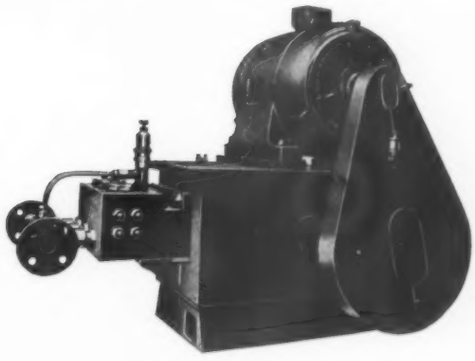

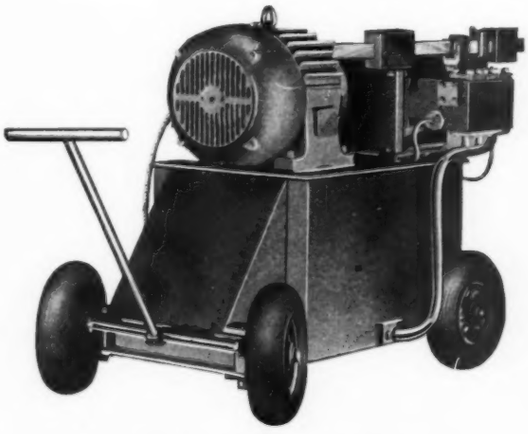

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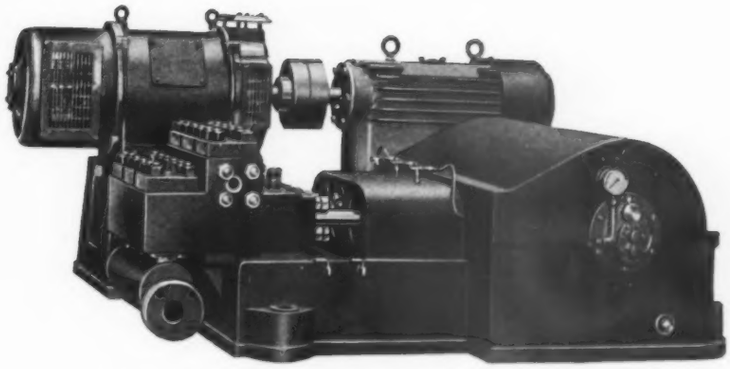

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instrument. For these reasons, among many others, the industry has needed one system of color measurement which will be applicable to all types of petroleum products, and which will provide a continuous relationship between the colors of dark- and light-colored products. Several attempts of this nature have been made prior to and since the development of the Saybolt instrument, leading to the development of the Stammer colorimeter, methods of using the Lovibond glasses, and color systems known as "true color" and "optical density."

All these methods failed in their objective for one reason or another. None of them is directly related to accepted systems of color definition. All are not only subject to peculiarities of the individual instrument, but lean heavily upon the personal equation. Furthermore, for light-colored oils, these systems require cell depths appreciably greater than used for darker oils, which prevent use of a continuous color scale.

A new color index for the designation and determination of color, previously called "photoelectric color," has been proposed, and the designation of the colors of lubricating oils and darker colored petroleum products by means of this index has been described.

This color index conveys full color information concerning the oil. In addition to presenting this information in terms which are of immediate and direct significance in petroleum technology, advantage is taken of the substantially invariant color properties of these series of products—that is, dark-colored petroleum products, light-colored petroleum products, fatty oils, etc. By so doing, all the desired information can be given despite the use of less than three parameters, in the present instance, only one parameter.

The color index consists of two terms, the second being zero when the color is "normal" or when it is that of light-colored petroleum products. The first term is the North Sky reading and the second is the deviation of the red reading from the normal at that North Sky reading. By reporting deviation from the normal red reading rather than the red reading itself, one can tell at a glance whether the oil is greenish or reddish and to what extent. For example, a color index of $90 + 3$ would represent a North Sky reading of 90 and a red reading of 100 and the oil is on the reddish side of normal. An index of $90 -$ represents a North Sky reading of 90 and a red reading of 94 and the oil is greenish to the extent of 3 units. When the second term is zero, it will often be omitted.

This system expresses and measures directly what the eye sees. It does so by measuring the equivalent of the energy received by the average eye looking through the sample toward C illuminant, and it also measures variations in hue.

REFINING

Handling Sour Crudes—J. P. O'Donnell, in OIL AND GAS JOURNAL, vol. 42 (1943), No. 4, pp. 27-28, 50.

The growing tightness of the crude oil situation indicates that refineries in Districts 1 and 2 will find it necessary to run sour crudes, even those from West Texas. In view of this situation the Standard Oil Company of New Jersey, which has been running large quantities of West Texas crude for several years, has made available information on the subject.

West Texas crude oil normally has from 1.5 to 2.0 percent of sulphur, of which 15 percent may be in the form of H_2S. The presence of H_2S makes such oil highly corrosive, and, in addition, H_2S is a dangerous, poisonous gas. It is therefore necessary to take measures for protecting the equipment, and it is even more important to take measures for protecting the personnel. Corrosion arises from evolution of H_2S and also HCL (from the salts normally associated with this crude) during the distillation process. The corrosivity due to HCH may be reduced by mixing the crude oil with a solution of $Na\ CO_3$ just ahead of the shell and tube preheaters; the amount of this neutralizing agent must be carefully controlled and adjusted to the varying character of the crude oil. During the primary distillation anhydrous ammonia is introduced into the overhead equipment to keep the water in the distillate stream at approximately 6.5 pH; 0.011 lb. of NH_3 per 100 gals. of feed were used in a typical case. Enough water should be present to dissolve and remove the salts formed during neutralization, otherwise the equipment will be fouled. The virgin naphtha from the crude tower is apt to be high in H_2S, which is most cheaply removed in the stabilizer with the propane, and this cut used as fuel. Sweetening or acid treatment followed by soda washing may be practiced before rerunning. The same neutralizing agents may also be needed in

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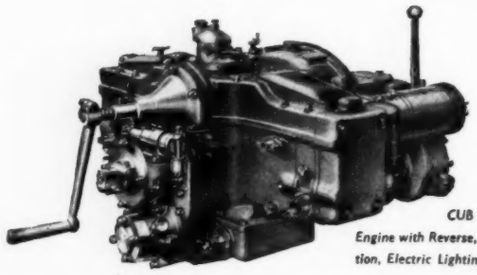

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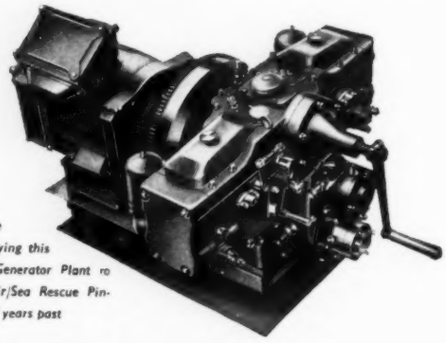

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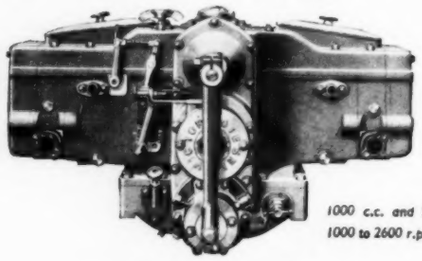

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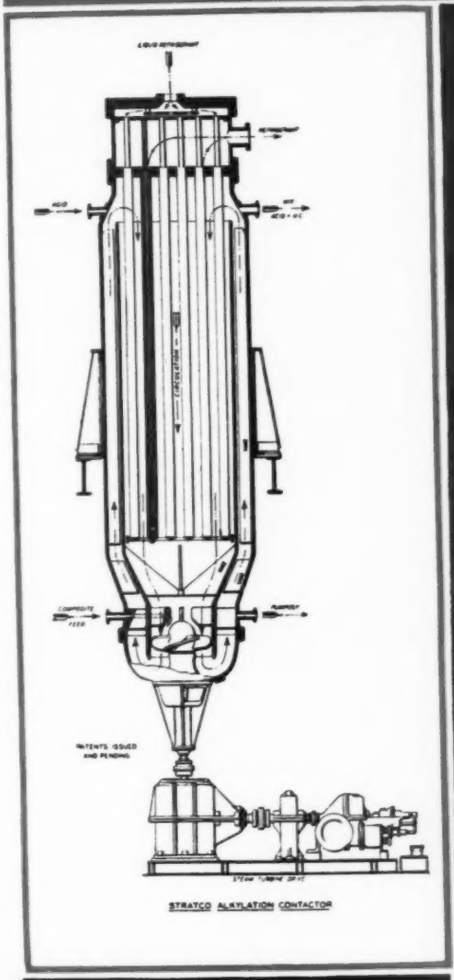

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rerunning. There is an advantage in topping the crude in shell stills to remove H_2S prior to feeding the stock to the pipe stills. Alloy steel is needed in some parts of the preheaters, the pipe still and parts of the fractionating tower, and in some places solid monel is required. Gunite linings are useful in certain cases.

The West Texas crudes are regarded as frankly dangerous to personnel, and elaborate safety rules have been formulated; as little as 0.01 volume percent of H_2S in the air causes irritation and 0.05 percent by volume may cause failure of respiration. For this reason all refinery employees are trained in the prone pressure method of artificial respiration. In all operations involving sampling and gaging two men are required, both equipped with canister-type gas masks, and in remote locations three men are required. No one is allowed to go to the top of treating tanks when dangerous distillates are being processed. Thorough washing or blanking must precede major repairs, and all sewers must be effectively trapped. If the crude oil is received by tank cars special precautions should be taken to protect the tank-car unloading crews.

Refinery gases may show hydrogen sulphide content as high as 5 percent. It is therefore obvious that extreme precautions must be taken in case of a leak in the gas system or if it is necessary to open the lines.

USES

Peacetime Uses of Synthetic Rubber—Information released by HYCAR CHEMICAL COMPANY, 1943.

It is pointed out that synthetic rubbers have certain points of superiority over natural rubber which seem to guarantee that the new materials will never be replaced by natural rubber, regardless of the availability or the price at which natural rubber may be offered after the war. This state of affairs may help to assure oil companies embarking on the manufacture of butadiene that they will hardly lose their market when peace comes.

Certain recent tests have already demonstrated that synthetic rubber tires under 35 percent overload could travel 37,000 miles at 60 miles per hour. The tires used in these tests were compounded with a new type of carbon black. From this and other reasons it is inferred that "if" the present rate of developing new compounding materials continues we shall have synthetic tires that will last for the normal life of the car. Besides durable tires there are a host of rubber products used in machinery and industry that are so distinctly superior to natural rubber that it is scarcely unthinkable that they will be discarded in favor of the natural product. The great superiority of synthetic rubbers in all situations where oil products come into contact with the rubber is now well known. The gruelling experience of the armed forces in frigid and torrid regions has indicated other superior qualities. Tubing of synthetic rubber will withstand temperatures up to 300° F. and operating conditions where natural rubber would be speedily destroyed. Butadiene rubbers have greater ability to absorb vibrations, which admits large use in engine mountings. The synthetics have better resistance to sunlight, and to deterioration through contact with certain metals, and hence will be indispensable in electrical insulations and valve fittings.

It is said that bearings lined with synthetic rubber and operating in oil will greatly lessen troubles which are prevalent with metal bearings. Important uses are foreseen in the waterproofing of paper and textiles, and in the manufacture of artificial leather. The above by no means exhausts the field in which the synthetic rubbers have demonstrated their supremacy.

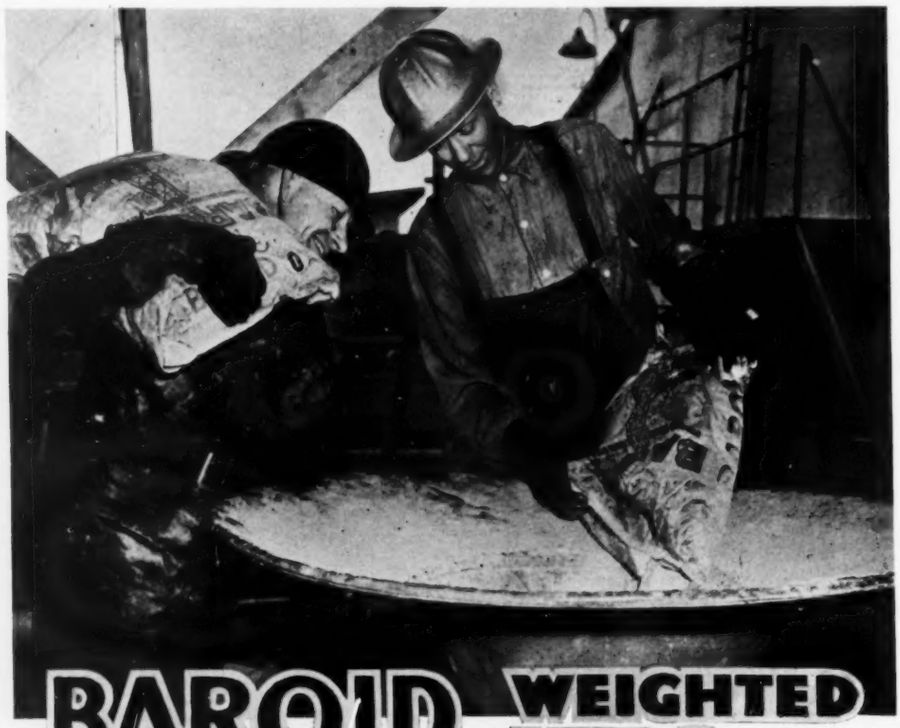
GENERAL

Effect of Petroleum Products on Buna S Vulcanizates—Ross E. Morrs and Others, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 35 (1943), No. 6, pp. 646-649.

Buna S vulcanizates have been found to suffer serious losses in tear resistance when exposed to the influence of petroleum products, particularly the lighter variety. The conventional tests for swelling and loss of tensile strength in petroleum products are misleading when applied to Buna S vulcanizes because they give no indication of this failing.

A crude but informative experiment was performed which demonstrated the poor tear resistance of a Buna S vulcanizate when wet with kerosene. Slabs of a Buna S and a Hevea tread stock (Table I), each ¼-inch thick and 2¼ inches wide, were cured. The slabs were clamped tight around ⅜-inch o. d. tubing. A slit, about ¼-inch long and 3/32-inch deep, was cut crosswise on the outer periphery of the curved slabs. Kerosene was painted onto the slits with a soft hand brush. The rate of growth of the slits was timed with a stop watch. The slit in the Buna S stock soon cut through and, within 10 minutes, traveled almost the full width of the slab; the slit in the Hevea stock increased little in depth during this time.

Similar experiments on other Buna S stocks gave the same results.



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BAROID, the *pioneer* weighting material for drilling mud, has been successfully used in thousands of wells to control formation pressures and to prevent caving. Muds suitably weighted prevent blowouts. The speed of drilling operations is also increased. BAROID has a high specific gravity (almost twice that of most native clays) and will make pumpable muds weighing as much as 20 pounds per gallon (150 pounds per cubic foot). It may be added to the mud by means of a cone-and-jet type mixer, as shown above. BAROID is easy to transport and will not deteriorate in storage. BAROID is immediately available in 409 locations in the United States and Canada.

BAROID SAVES VALUABLE CASING
BAROID weighted muds have made possible the saving of thousands of tons of casing previously used protective strings can often be eliminated by sufficiently increasing the mud weight with BAROID to hold back caving or sloughing formations and high gas, oil and water pressures.

PATENT LICENSES on a royalty basis, unrestricted as to sources of supply of materials, will be granted to responsible oil companies and operators to practice the inventions of any and/or all of United States Patents Nos. 1,807,082; 1,991,637; 2,214,674; 2,294,877 and further improvements thereof. Applications for such licenses should be made to the Los Angeles office.

BAROID SALES DIVISION
NATIONAL LEAD COMPANY
BAROID SALES OFFICES: LOS ANGELES • TULSA • HOUSTON

BAROID PRODUCTS: BAROID and COLOX • AQUAGEL • FIBROTEX • BAROCO • STABILITE • AQUAGEL-CEMENT SMENTOX • ZEOGEL • IMPERMEX • MICATEX • TESTING EQUIPMENT • BAROID WELL LOGGING SERVICE